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Massachusetts Volunteers Guide for

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Surveying A Lake Watershed and

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Preparing an Action Plan

Commonwealth of Massachusetts ◆ Department of Environmental Protection ◆ 2001

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Lake Watershed Survey—Introduction

Section 1

What's Here?

Lake Watershed Surveys
About the Guide

Community volunteers are energizing efforts in Massachusetts to restore bodies of water to healthier conditions. By collecting information and educating themselves and others about water quality problems, volunteers are strengthening stewardship for the environment in the Commonwealth. Today, the number of volunteer groups taking on challenging water quality problems in lakes, streams, coastal waters, and wetlands is growing. Neighborhoods, businesses, organizations, and government are coming together to solve environmental problems in new and more effective ways. Local leaders and citizens like you are taking responsibility and working together with other communities to find and correct pollution problems that are damaging local waterbodies.

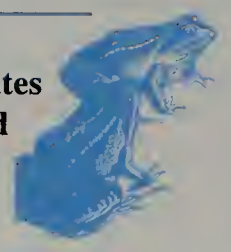
Designed for citizens and local leaders, this Lake Watershed Survey guidance empowers community volunteers and provides the tools to identify and alleviate common sources of pollution that are associated with different land uses. This guide includes basic information about water pollution and lakes, direction for working with a steering committee and volunteers, a step-by-step process for conducting a lake watershed survey, and considerations for recommending and implementing a lake management action plan.

Lake watershed surveys

Lake watershed surveys can help protect water quality and aquatic life. The primary objective of a survey is to locate as many potential pollution problems in the watershed as possible. By identifying sources of pollutants within the watersheds of Massachusetts lakes, volunteers will bring attention to issues that need to be corrected. A second, equally important objective is to help the watershed community understand how land use influences lake water quality. Once awareness is raised, people are more likely to change habits that are damaging to lakes.

Addressing a lake's water pollution problems on a watershed basis makes sense. A watershed is defined by the movement of water from the geographic high points to a common low point such as a river, lake, or bay. Thus, the flow of rain and snowmelt on and in the ground is along pathways that are defined by watersheds. Because of these flow patterns, surface and ground water transports pollutants within a watershed, rather than along municipal or other created boundaries. Consequently, neighboring communities are connected by the water within a watershed, and they share the responsibility to protect it.

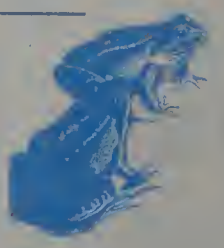
Bold italics indicates that there is related information in an Appendix.



Clean lakes are vital to Massachusetts' economic and ecological well-being. Massachusetts lakes are used for drinking water, recreation, and flood control. Lakes also provide wildlife habitat and irrigation for farmland. However, despite regulatory protection, such as the Rivers Protection Act, the Wetlands Protection Act, and Title 5, hundreds of Massachusetts lakes have pollution problems, including an overabundance of aquatic plants and algae, a buildup of sediment, infestation of nonnative plants, and mercury contamination in fish. Pollution impairs or reduces the ways in which Massachusetts lakes may be used. Pollution can make water unsafe or unhealthy to swim in and can cause restrictions or prohibitions of fish and shellfish consumption. It also can lead to expensive treatment of drinking water in reservoirs. As clean water becomes less plentiful, protecting lakes and eliminating pollution becomes critically important to all of us.

This Lake Watershed Survey guidance has been developed by the Massachusetts Department of Environmental Protection to support the state's Total Maximum Daily Load (TMDL) program for lakes.

A TMDL is defined as the greatest amount of pollution a waterbody can accept without causing impairment and still meet the Clean Water Act standards.



Today, the federal and state governments are approaching water quality problems in a systematic way using the TMDL provision in the federal Clean Water Act. TMDLs are required for all waterbodies–such as lakes–which are impaired by pollution. The ultimate goal of the TMDL program is to assure that all waters in the nation can be used and protected, appropriately.

In practical terms, developing a TMDL requires knowledge about the sources, types, and amounts of pollution that are causing damage to a lake or waterbody. Once the pollution problem is understood, a determination is made of the amount of pollution that can be tolerated by the waterbody. That amount is divided among all the sources of pollution, including piped groundwater and over land runoff that flow into the waterbody. In most cases, sources of pollution will need to be reduced or eliminated to attain acceptable pollution levels, and landowners will need to take greater

The Importance of Watershed Surveys

- **Raise awareness to protect lakes from nonpoint source pollution.**
- **Collect information to track changes in the watershed.**
- **Determine watershed problems, their location, and seriousness.**
- **Give landowners information on how to reduce nonpoint source pollution on their property.**
- **Provide information for a lake management action plan to protect and restore the lake.**

responsibility for watershed stewardship. This will require some changes in current land use activities, storm drain systems, and other practices with discharges to waterbodies.

The guide describes a simple and effective visual assessment method to identify existing and potential sources of problems in a lake watershed. Other lake assessment and monitoring techniques also are used to evaluate the environmental conditions of Massachusetts lakes and ponds. While separate from this survey, in-lake and shoreline studies can be used to supplement this lake watershed survey. Although soil erosion issues are emphasized in this survey, the guidance includes land use activities that also contribute to the phosphorus and sediment problem in lakes. Since much of this damaging lake pollution comes from private land, volunteers will need the cooperation of landowners to reduce pollutants at their sources. By participating in this important work, volunteers and landowners will gain a better understanding of land uses and their impacts.

Thank you for sharing your talents and giving your time. As you visit sites and gather information, there will be an opportunity to share knowledge with residents and landowners in the watershed. Take advantage of these opportunities; they will help improve decisions made at the local level, and your enthusiasm may inspire greater community involvement.

About the guide

Volunteers who are new to lake watershed surveys will have a lot of questions about the work they will be undertaking. This guide explains what is expected of volunteers before, during, and after the lake watershed survey. This guide is not an in-depth resource on topics, such as lake pollution and nonpoint pollution best management practices. However, there are references, a bibliography, Web sites, and funding sources in the appendices for those interested in pursuing lake resource issues beyond the scope of the guide.

The guidance is divided into five sections, and is organized as follows:

Section 1 - Introduction provides information on lake watershed surveys, discusses the purpose of the guidance, and outlines the structure of the document.

Section 2 - Understanding Lake Pollution introduces volunteers to the lake pollution problems that the survey is addressing.

Section 3 - Organizing a Lake Survey provides an organizational framework for steering committees.

Section 4 - Steps for a Lake Watershed Survey: Field Volunteers describes the step-by-step process for conducting a lake watershed survey. It is written for field volunteers, but the steering committee also will find it useful.

Section 5 - Getting Results from the Survey is for the steering committee, field volunteers, and others interested in interpreting the survey results and translating them into a work plan of objectives and recommended activities.

The guidance also can be used to support the training workshops for volunteers. Appendices contain frequently asked questions, references, sample survey forms, a glossary, case studies, guidance for reading topographic maps, and who to call for help. Lake associations, watershed and civic groups, and municipal officials are invited to organize and join a lake watershed survey. With many impaired lakes in Massachusetts, your volunteer support is needed to identify and address lake watershed water quality problems.

The document is based, in large part, on *A Citizen's Guide to Lake Watershed Surveys: How to Conduct a Nonpoint Source Phosphorus Survey,* April 1997, prepared by the Congress of Lake Associations and Maine Department of Environmental Protection (DEP). Inspired by the success of lake watershed surveys conducted in Maine, the Massachusetts DEP adapted Maine's survey process to encourage similar survey efforts by community volunteers in Massachusetts.

Understanding Lake Pollution—The Basics

Section 2

What's Here?

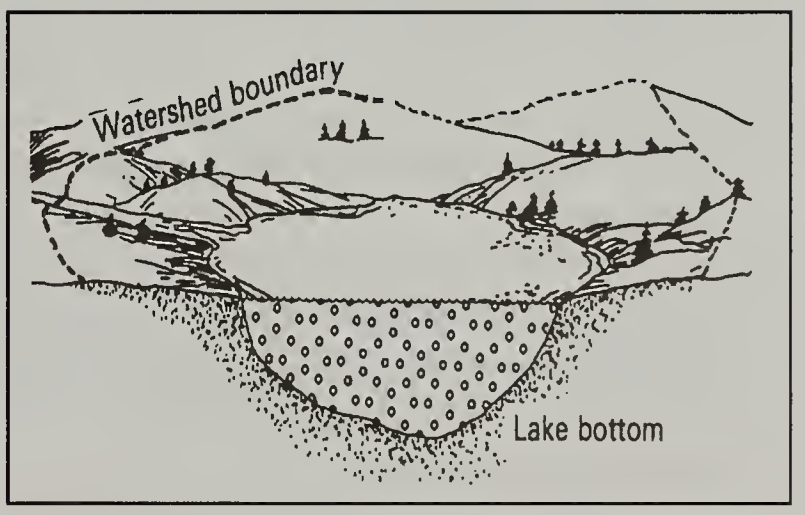
Why are Lakes Sensitive to Pollution?
Phosphorus-A Damaging Pollutant
Land Use and Phosphorus
Can a Lake's Health be Restored?

Why are lakes sensitive to pollution?

Lakes are constantly receiving environmental pollution and other substances from the air, land, and water around them. Lakes can be very susceptible to damage from this uninterrupted bombardment of airborne and waterborne pollution because water exchange can be very slow, compared with streams, rivers, and coastal waters. In general, pollutants tend to stay longer in lakes, which provides a greater opportunity for impairment. Lake water is a blend of incoming water, airborne materials, and resident lake water.

A lake's pollution problem reflects what is happening on the land surrounding the lake–***the lake watershed.*** A watershed (for any body of water) is the land area which defines and directs the downhill flow of water, from the highest elevations to the body of water at the lowest elevation. A lake's watershed includes all the surrounding land that captures and drains water–through streams, ditches, groundwater, or directly over the land's surface–into the lake. Even though a watershed may extend many miles away from the lake itself, the watershed is part of the ***lake ecosystem***, and the two cannot be separated. Whatever happens in a lake watershed affects the lake ecosystem.

The health of a lake is affected by a combination of physical, chemical, and biological factors that make up the lake's ecosystem. Physical characteristics, such as the size and depth of the lake, the size of the watershed relative to the lake area, steepness of terrain, and location of streams, have an effect on lake sensitivity to pollution. Lake sensitivity also is affected by chemical factors, which may be associated with climate, the types of soils in the watershed, soil fertility and erodibility, and nutrient enrichment. In addition, biological factors relating to lake habitat and the plants and animals in the watershed will influence the condition of a lake and its sensitivity to pollution.



Where does lake pollution come from?

Nonpoint source (NPS) pollution is the greatest threat to lake water quality because it exists in many forms that are often difficult to pinpoint and control. NPS occurs when rainwater, snowmelt, or water for irrigation flows over the land, picking up pollutants and depositing them into rivers, lakes, coastal waters, or groundwater. Until recently, the focus of water protection laws and regulations has been on direct or ***point source pollution***, which comes from a discrete source or single outlet such as a discharge pipe at an industrial plant or wastewater treatment plant.

Heightened public awareness, legislation, and improved control technologies have reduced point source pollution. A great deal of progress has been made in the past few decades to reduce pipe discharges to lakes, rivers, streams, and oceans.

NPS pollution, on the other hand, exists wherever there is human activity. Residential, commercial, urban development, roadways, parking lots, agriculture, forestry, and industry all contribute pollutants that degrade water quality. These land uses not only create pollution, they also cause it to reach the lakes more readily by increasing the amount of runoff from rain and snowmelt and channeling it more directly.

The decline of lake water quality as a result of human activity in the lake watershed is referred to as ***cultural eutrophication*** (over-enrichment of the lake from human actions). The result is an acceleration of a lake's "aging" process (called succession) that can have far-reaching consequences on watershed communities, including:

- Reduced swimming and boating appeal;
- Loss of habitat and changes in fishery as habitat disappears;
- Increased expense of treating drinking water;
- Loss of shorefront property value;
- Reduced community tax revenues; and
- Increased costs to communities for lake improvement or restoration.

A lake's watershed consists of all the surrounding land that drains into the lake. Watersheds can extend for miles.

The pollutants carried in stormwater runoff may include ***nutrients*** like ***phosphorus*** and nitrogen, biological matter (viruses and bacteria), and ***toxic*** substances like heavy metals. Materials may be dissolved in runoff or they may be attached to sediment particles. Lakes are particularly sensitive to phosphorus and ***sediment*** particles.

Many Massachusetts lakes have been seriously damaged, and many more are considered at risk from pollution. The 303(d) list of impaired waters, prepared by the Massachusetts Department of Environmental Protection (DEP), concludes that about 727 lakes do not meet water quality standards established by Massachusetts law. The deteriorating quality of these lakes is evident by problems such as dense growth of non-native and invasive plant species, nuisance ***algal blooms,*** and metals, particularly mercury in fish. Most of these problems are associated with excess nutrients and sediments in the water.

How does land development speed up the transport of pollution into lakes?

Stormwater runoff is one of the main pathways for pollutants, such as phosphorus, to travel from the upper elevations in a watershed to a lake. The volume of stormwater runoff and the amount of phosphorus in the runoff depends on how land throughout the watershed is being used (Table 1, pg. 14).

Forest land in undeveloped lake watersheds acts like a large sponge. The irregular depressions and rich organic ***duff layer*** on the ground surface absorb runoff from heavy rains and snowmelt, trapping and filtering the water.

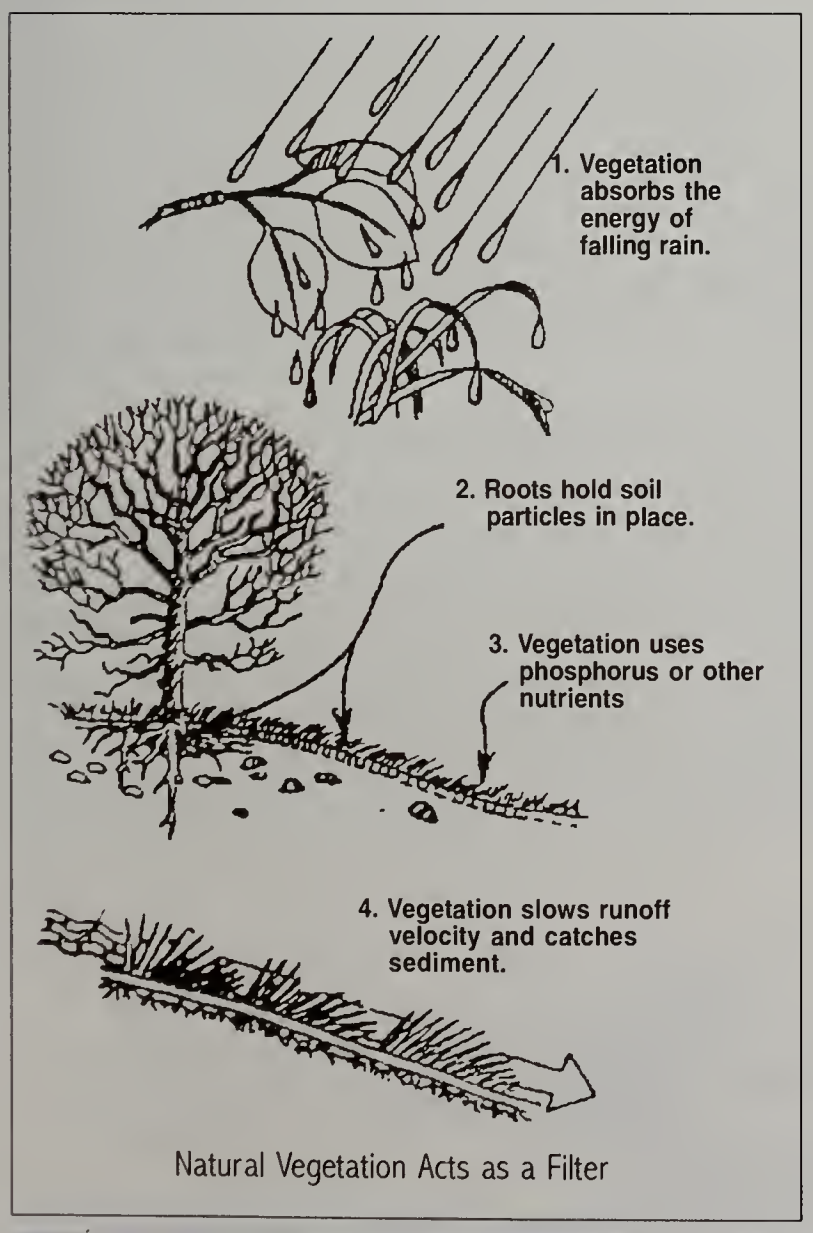
The forest's tree canopy breaks the ***velocity*** of rain, which reduces soil erosion and allows moisture to be absorbed into the ground. Smaller trees and woody shrubs provide additional protection against erosion by binding the soil with their dense root systems.

Much of the phosphorus trapped by the natural filtering action of soil particles and vegetation is then taken up by the forest vegetation. As a result, the water that flows to the lake contains relatively little phosphorus.

As a watershed is developed, trees and ground cover vegetation are removed. Soils are disturbed, compacted, and covered with pavement and structures. Natural ground surface irregularities are smoothed out to create lawns. Much of the rain and snowmelt that would have been absorbed into the ground runs off the surface of roads, parking lots, buildings' rooftops, fields, and lawns.

Ultimately when land is developed from its natural condition, and replaced with paved and impervious surfaces, the volume of stormwater runoff increases. Higher volumes increase the velocity at which the runoff moves through the watershed. With both increased volume and velocity, runoff travels greater distances toward streams and lakes. The added force of the runoff causes erosion of more soil from road surfaces, shoulders, ditches, stream channels, and shoreline areas.

A multitude of pollutants may be picked up and carried in runoff from developed areas. Soil particles, road salt, lawn fertilizers, herbicides, pesticides, animal excrement, oil, and gasoline residues from streets and parking lots are just a few of the potential pollutants in runoff from developed watersheds. Typically, phosphorus concentrations in runoff from developed areas are much higher than they are in runoff from an undisturbed forest.


1. Vegetation absorbs the energy of falling rain.
2. Roots hold soil particles in place.
3. Vegetation uses phosphorus or other nutrients
4. Vegetation slows runoff velocity and catches sediment.
Natural Vegetation Acts as a Filter

Phosphorus — A Damaging Lake Pollutant

What is phosphorus?

Phosphorus is a natural substance found in nearly all plant and animal matter. It is an important building block for plant and animal cell ***metabolism***, and it is a nutrient (fertilizer) essential to all living organisms. Nearly all soils contain phosphorus. Fine soil particles like clays, silts, and rich organic soils contain very high concentrations of phosphorus. Septage, manure, and street runoff also contain high concentrations. Phosphorus is a common ingredient in lawn and garden fertilizers, and is found in gasoline and oil residues.

What are the effects of too much phosphorus on lakes?

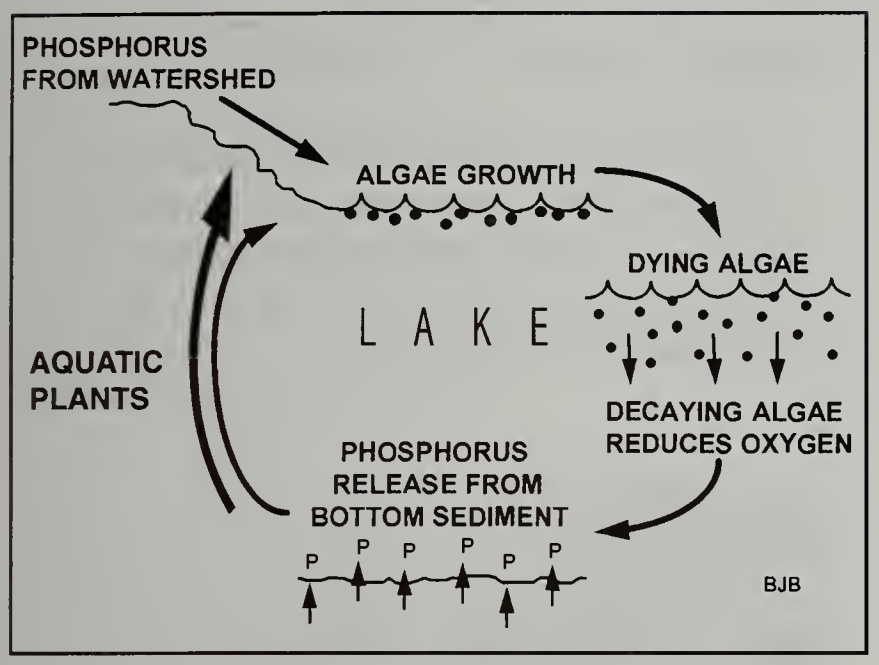
Lakes are very sensitive to phosphorus and other nutrients. The amount of phosphorus influences biological growth in a lake. Even small increases of phosphorus can cause problems.

The amount of phosphorus in lake water determines the amount of vegetation–the more phosphorus that reaches the lake, the more ***algae*** and aquatic plants that can grow. Although algae are an important component of the lake ***food chain,*** too much algae growth causes the water to turn green and cloudy, and generally undesirable for most recreational uses, especially swimming, and balanced aquatic life.

Table 1: Land Use and Phosphorus

Land Use	Source of Phosphorus	Comments
Agriculture	• Tilled soil • Animal waste • Fertilizers • Diverted field runoff that flows into road ditches • Unstable stream banks, or shoreline areas from livestock grazing	Agriculture creates the potential for high phosphorus runoff. There may be large areas of exposed soil, concentrated water diversions, fields tilled too close to road ditches, and livestock grazing too close to streams or the lake. Runoff from manure storage areas can also be a serious problem.
Commercial/ Urban Development	• Exposed soil from construction sites • Gasoline and oil residues from road surfaces • Sand and gravel from roads • Large paved areas and parking lots without adequate stormwater controls	High runoff volumes from buildings and parking areas can erode streambanks. Urban runoff contains moderately high levels of phosphorus and many other pollutants that are potentially harmful to water resources. Sand spread on roads in winter is easily washed into storm drains, streams, and ultimately into the lake.
Residential Development	• Soil erosion from construction sites • Soil erosion from subdivision and camp roads • Runoff from fertilized lawns and gardens • Animal waste (pets) • Failing septic systems	The phosphorus pollution potential is high partly due to rapid growth of residential development in many watersheds. The cumulative phosphorus load from residential areas (including roads) throughout the watershed can easily exceed all other land uses in the watershed combined.
State and Town Roads	• Soil erosion from road surfaces, shoulders, and ditches • Erosion from unstable banks or bridge scour • Ditches discharging directly to streams • Inadequate stormwater controls (e.g., catchbasins, detention ponds)	A significant source of sediment in most watersheds is the extensive network of roads and inadequate construction and maintenance standards.
Forestry Operations	• Soil erosion from skidder trails,clear cuts, log yards, logging roads, and stream crossings	Forestry operations can be a high source of phosphorus due to soil exposure and erosion from logging trails. Streambank erosion may occur due to increased runoff from heavily logged sites.

Phosphorus Effects in a Lake



Excess algae growth also can cause a decline of oxygen in the water. This can seriously impair aquatic ***habitat,*** resulting in the slow decline of some sensitive species such as trout and salmon. In extreme cases, algae "blooms" can cause thick, foul-smelling scums to form on the water surface, and large numbers of fish and other organisms may die from oxygen depletion. Left uncontrolled, the effects of cultural eutrophication will result in the lake's decline.

Measuring phosphorus — How much is too much?

Natural phosphorus levels in lake water are normally so low that they are measured in parts per billion. A part per billion (ppb), is equivalent to 1 grain of salt in about 35 gallons of water. Lakes that have phosphorus levels in the 3-5 ppb range are typically clear and have good water quality. Levels of only 15 ppb or more, however, can cause lake water to turn green from excess algae growth. Phosphorus concentrations in Massachusetts lakes range from approximately 3 to 100 ppb, with a relatively high average level of 18 ppb.

A lake's watershed consists of all the surrounding land that drains into the lake. Watersheds can extend for miles.

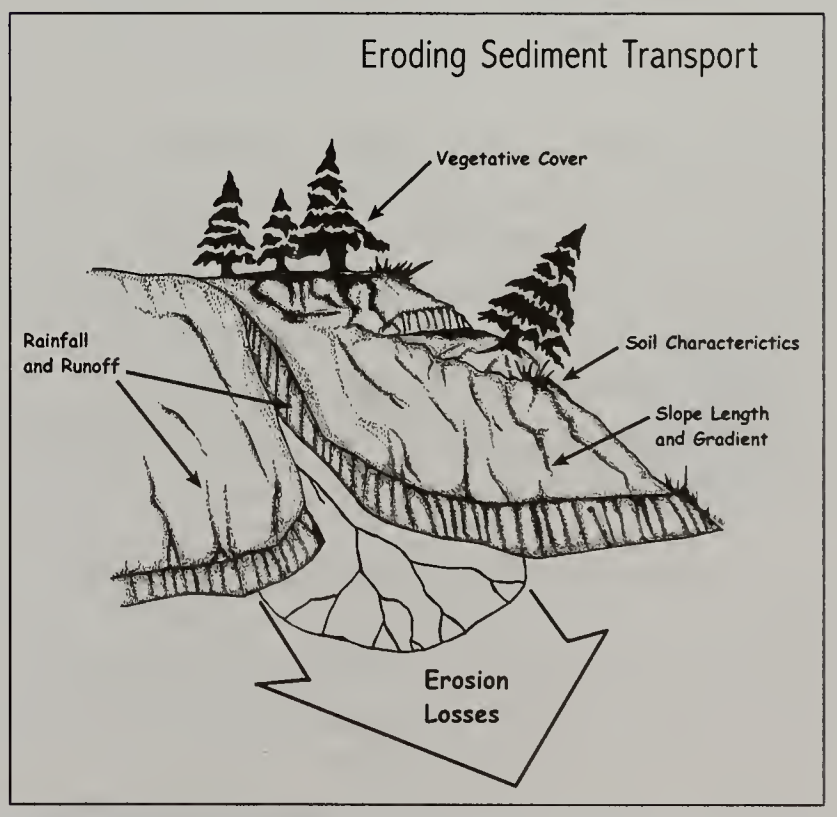
Soil erosion and phosphorus.

Fast-moving stormwater accelerates land ***erosion***. Eroded sediment is transported downstream into streams, rivers, and lakes, where it eventually settles out. When soil particles erode, they travel with the runoff. Dissolved phosphorus and very small soil particles can travel great distances in stormwater runoff. The erosion and sedimentation problem is enormous—it has been estimated that as much as 80 million tons of sediment a year are eroded from construction sites. Because phosphorus and sediment can affect lake water quality so negatively, this guide places emphasis on identifying and reducing sources of stormwater runoff and sediment enriched with phosphorus.

Detached soil particles (sediment) from eroded areas also can cause serious damage to the streams that feed a lake by smothering sensitive habitat for fish and aquatic insects. Sediment that travels to the lake causes similar damage.

You can actually see the difference.

The difference in runoff quality can be easily seen during a rainstorm. Look at the runoff from a residential or commercial area flowing through a road ditch or small stream. Compare it with that of a small brook in the forest. Runoff from forested areas does



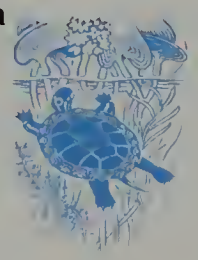
not begin to flow until the soil is saturated with water and natural depressions in the forest floor have filled.

In developed areas, runoff begins to flow almost immediately off the ***impervious surfaces,*** such as paved roads and roof tops. Also, the appearance of the water differs significantly. Runoff from developed areas is normally brownish-gray in color. But runoff from stable, forested areas is usually clear, except in severe storms where it may become cloudy due to soil erosion.

Certain land uses release higher phosphorus levels in stormwater runoff.

Phosphorus contributions from different land uses vary significantly from one lake watershed to another. Studies have been done to estimate the approximate amount of phosphorus released by certain land uses. These study results can be used to roughly predict a lake's annual ***phosphorus load,*** based on the land uses and soil types in its watershed, and to estimate how much the lake may be degraded.

Collect water in a mason jar from a forested lake. Compare it with lake water from a residential neighborhood. Photos of the two jars are effective for public presentations.



These studies and the predictive models developed from them do not specifically pinpoint the problems causing degradation, however. That information is best determined through a watershed survey. Locating the problems and describing their nature and severity provides valuable information about the extent of problems and the overall character of the lake watershed.

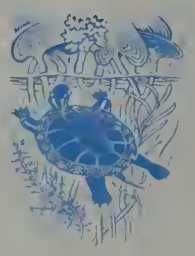
The degree to which pollutants threaten a lake depends on everything that's happening in the watershed–how the land is being used, the extent of development, and the way ***surface water*** travels down through the watershed to the lake. The location of streams, soil type, and variations in the slope of the land are all factors that affect the way NPS pollutants travel to lakes. A visual lake watershed survey like this one helps to determine what's happening in the watershed and how that affects the lake.

All of the land in a lake watershed contributes phosphorus to the lake, including the undeveloped land. Different land uses have the potential to contribute greater or lesser amounts of phosphorus, depending on a number of factors.

These factors include:

- Where the development is located in the watershed (i.e. is the developed area on steep slopes, poor soils, near streams or the shoreline);
- How large an area has been developed for each type of land use;
- Whether or not measures are being used to control soil erosion and stormwater runoff; and
- How long the developed area has existed.

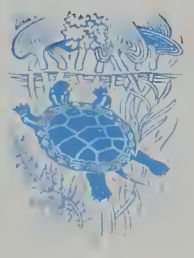
By the time pollution effects are obvious, a lake can be difficult or impossible to restore.



For example, in a small watershed with moderate shoreline development, much of the phosphorus would probably be coming from the lakeshore development. But in a watershed with a large upland area away from the shoreline, general residential development, forestry operations, farms, and commercial development would probably all be contributing to the lake's phosphorus load.

A lake watershed survey helps determine *where,* and *what,* the problems are. It helps us understand whether or not particular *types* of land uses are problematic. For instance, new construction activities in a particular town may not have ***erosion controls*** installed to keep soil from eroding off the site. And most important, the survey nearly always confirms that the problems are not just the large, obvious ones. There are many small situations that are commonly overlooked. Small problems add up and can cause serious water quality problems.

A lake watershed survey identifies problems and educates the public about land use activities.



Using Clearwater Lake in Maine as an example, the pie charts show comparative differences in the amount of phosphorus that leaves each land use annually, relative to the percent land use in the watershed. Although nearly 80% of the watershed is covered with forest and wetland, only 9.6% of the phosphorus comes from these land uses. On a per-acre basis, roads, agriculture, and commercial development export the greatest amount of phosphorus. However, residential development is the fastest growing land use in most lake watersheds. Residential development exports much more phosphorus than the forest.

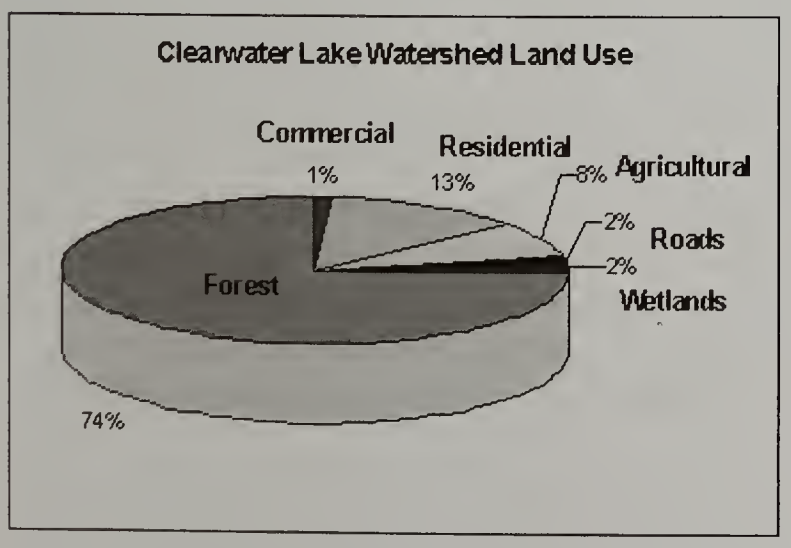


Figure 1 shows, in percentages, how land in the watershed is being used.

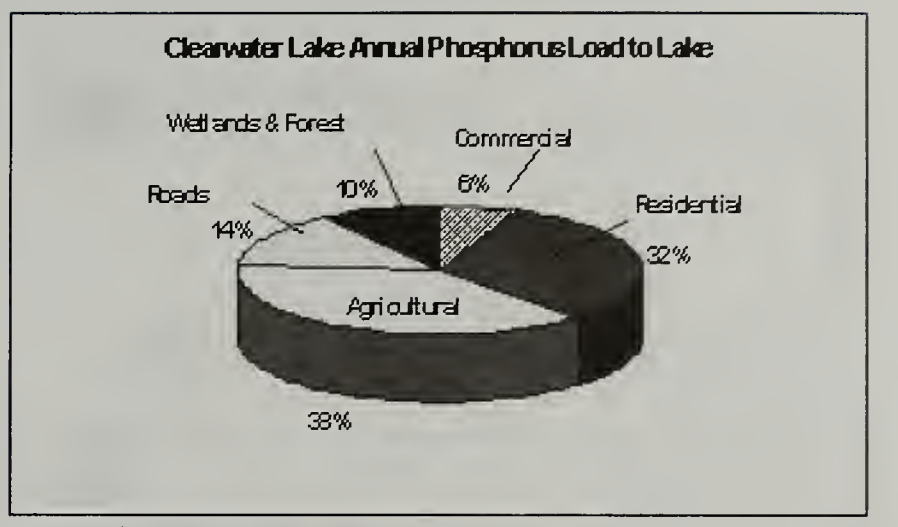


Figure 2 shows an estimate of how much phosphorus leaves each land use annually.

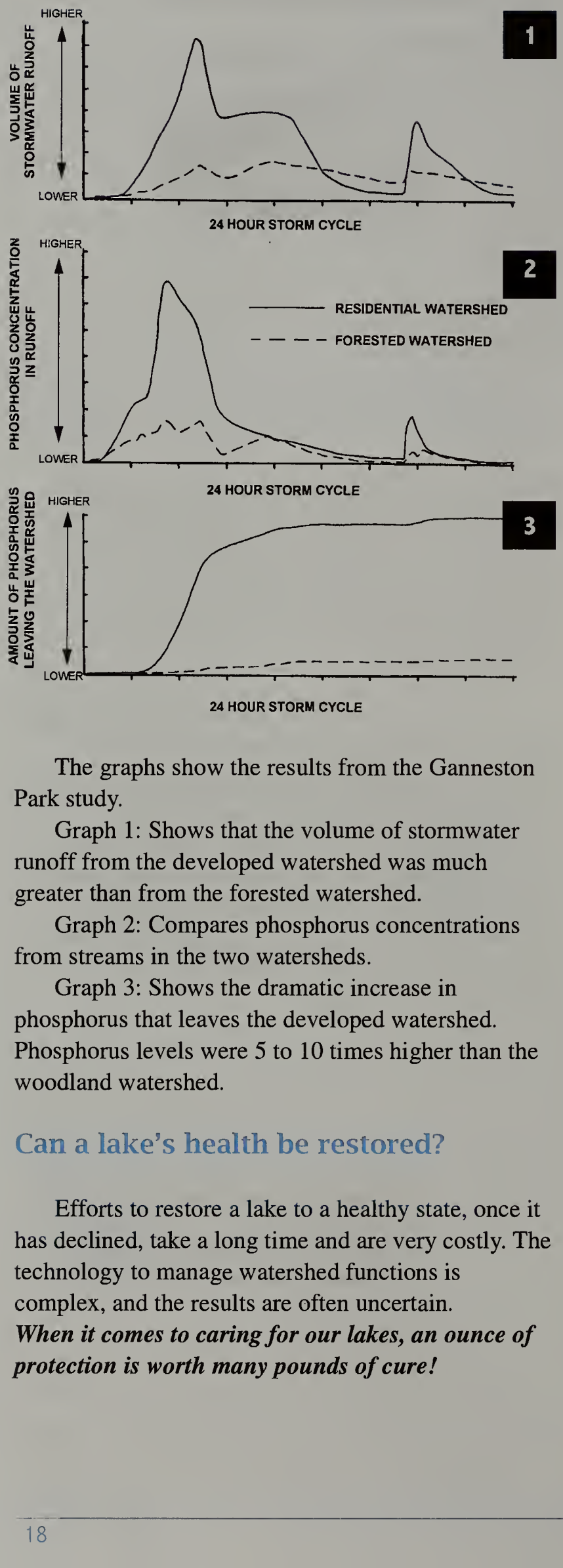
A comparative study of two watersheds in Ganneston Park, Maine.

How does watershed development affect lake water quality? One Maine study suggests that even low-density residential development has a high potential to degrade lake quality, unless protective measures are used to reduce phosphorus levels in stormwater runoff.

In 1983, the Maine Department of Environmental Protection studied and compared runoff from two adjacent Central Maine watersheds for one year. The watersheds had similar characteristics and topography, but one was essentially undisturbed with a mature woodland cover, while a portion of the other had been converted to a residential development. This relatively low-density development consisted of one-acre lots with typical suburban construction—houses, lawns, and roads.

Phosphorus from a lake watershed can be reduced, by identifying and eliminating the majority of soil erosion problems.

Ganneston Park Study



The graphs show the results from the Ganneston Park study.

Graph 1: Shows that the volume of stormwater runoff from the developed watershed was much greater than from the forested watershed.

Graph 2: Compares phosphorus concentrations from streams in the two watersheds.

Graph 3: Shows the dramatic increase in phosphorus that leaves the developed watershed. Phosphorus levels were 5 to 10 times higher than the woodland watershed.

Can a lake's health be restored?

Efforts to restore a lake to a healthy state, once it has declined, take a long time and are very costly. The technology to manage watershed functions is complex, and the results are often uncertain. ***When it comes to caring for our lakes, an ounce of protection is worth many pounds of cure!***

During the past two decades, a number of Massachusetts lakes have undergone restoration efforts. Some lake restoration projects may cost hundreds of thousands, or even millions of dollars, and there is no guarantee of success. However, the potential for success is improved by reducing nutrients from the watershed.

Attempts to manipulate water quality through chemical treatment may only last for a few months, and usually no more than a few years. In the three year period from 1994 to 1997, the Department of Environmental Management (DEM) awarded nearly one million dollars from the Lake and Pond Grant Program for 127 projects at 113 Massachusetts lakes and ponds for improved best management practices. While there were improvements in water quality, this level of funding addressed only some of the lakes' problems.

Although many of Massachusetts lakes are impaired, it is more economical and ecologically responsible to prevent lakes from reaching the point where restoration is needed. Fortunately, many methods for preventing or alleviating NPS pollution are simple and inexpensive. These methods, however, must be accepted as an essential part of land-use planning and long- term management. Problems associated with existing development also must be addressed.

Landowners in lake watersheds need to become more aware of the sensitivity of lakes and accept greater responsibility for the stewardship of these fragile ecosystems. Watershed education will help. Many are still unaware that, cumulatively, landowners have the greatest impact on the health of a watershed. When municipal officials and landowners recognize the "cause and effect"of their activities on a lake's ecosystem, they will be more likely to change damaging practices. This is the first–and perhaps most important–step toward changing watershed behavior, in order to reduce water pollution and provide better lake and water resource protection.

Organizing A Lake Watershed Survey

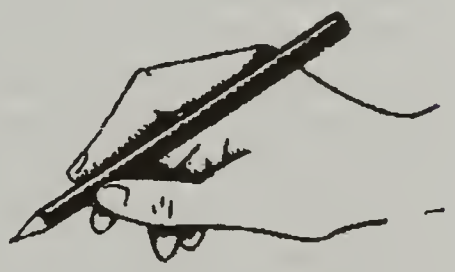
Section 3

What's Here?

The Steering Committee
Communication
Getting Support
Training Tips

Getting organized and establishing clear roles and responsibilities can ensure a successful lake watershed survey. The initial steps are organization of a steering committee and determining reasonable and acceptable goals for the survey to accomplish.

Organizers of the survey should begin by considering the benefits of conducting a lake watershed survey. An important benefit is raising public awareness of water quality problems in a watershed and the need to protect the lake's water quality. The survey becomes an effective tool for explaining watershed concepts. The survey also is a cost-effective way to gather land-use data, making it an important component in a comprehensive strategy for water quality protection. Landowners and community volunteers can become aware of erosion and runoff problems that may exist on their property and in their community.



The project schedule below shows a list of activities for a successful lake watershed survey. This schedule allows participants to set deadlines and structure certain activities for their specific lake watershed survey. Schedules can, and probably will, vary for each watershed.

Project Schedule

Target Date	Actual Date	Activity
		◆Organize steering committee and gather information about the watershed.
		◆Run article/notice in local newspaper. ◆Hold public information meetings. ◆Conduct training sessions for volunteers.
		◆Project advisors check ground conditions and decide on start date. ◆Begin the survey. ◆Trainers schedule a day in the field to help volunteers get started.
		◆Volunteers complete and return survey forms to volunteer coordinator. ◆Volunteer coordinator checks with each team to be sure work has been completed.
		◆The team reviews data and reports findings to discuss and resolve questions concerning field data.
		◆Prepare preliminary summary of findings. ◆Address problems with the group and consider contacting landowners. ◆Hold public meetings to present findings. ◆Prepare final report. ◆Seek funding and develop watershed protection strategies.

Steps in Organizing the Lake Watershed Survey

1. Form a steering committee to guide the survey.

A steering committee will be the guiding force behind the lake watershed survey. The committee is comprised of committed individuals who are aware of the problems in the surrounding watershed. The diversity of this committee can be seen by the representation of its members. Committee members should have the ability to facilitate group interactions and the ability to build and strengthen new and existing relationships within the watershed community. People from local lake associations, property owners' groups, business groups, and educators should be on the steering committee. Local, state, and federal representatives should be asked to participate. Members can include town selectmen, managers, planning board members, and boards of health. Steering committee members also might be found in watershed teams, conservation commissions, and state and federal environmental agencies.

Steering committee members will play a number of important roles throughout the survey. Committee members need to set project goals according to the needs of the community. They will develop a long-term comprehensive strategy for lake protection based on information gathered during and following the lake watershed survey. The steering committee will communicate with town officials, resource agencies, and the local media, as well as plan community information meetings. Another responsibility of the steering committee is recruiting volunteers and support personnel. Members of the group will be responsible for ensuring that field volunteers get the necessary training, checking identified sites, and preparing the final report.

Key roles in the lake watershed survey project are:

Survey Coordinator: Responsible for coordination of the specific projects, including overseeing the activities of the steering committee.

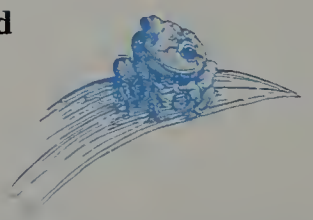
Volunteer Coordinators: Responsible for coordinating activities of the volunteers, including distribution of materials and the collection and preliminary review of data. These individuals will assist volunteers on technical issues, training, conducting follow-up work in the field, and writing the final report.

Documentation of organizational time may prove valuable in demonstrating the level of commitment that a group of individuals, an organization, or town has made to the project. This may be very useful if additional assistance is needed for a follow-up project that may have been identified in the survey. The amount of time will depend on the size of the watershed and the level of detail in the Lake Watershed Action plans.

2. Identifying concerns and issues.

Why conduct a lake watershed survey? Be prepared to answer this question. Is there a specific problem with the lake that justifies the survey? If not, does the watershed community recognize the value and sensitivity of the lake, and want to protect and maintain that value? These questions should be answered early in the organizing process.

Each town in the watershed should be represented on the steering committee, regardless of whether the lake itself is in those towns.



Before enlisting help from the public and agencies or organizations, project organizers should be able to define the concerns and basic issues. Much of the background information needed to discuss the issues is included in *"Understanding Lake Pollution,"* Section 2 of this manual. Often, additional information about the lake can be obtained by contacting the Massachusetts Department of Environmental Protection ; Bureau of Resource Protection; Watershed Planning Program; the Department of Fisheries and Wildlife's Riverways Program; the Executive Office of Environmental Affairs (EOEA) watershed team leader; or the Department of Environmental Management (DEM) Lakes and Ponds Program. ***(See Appendix D for contacts.)***

There may be a great deal of information already available about the lake and its watershed. Watershed maps are available from DEP and EOEA watershed team leaders. Soil and aerial survey maps are available from the Massachusetts Geographic Information System (MASS GIS) and Natural Resource Conservation Service (NRCS). Towns may have drainage maps available. Conservation commissions also may have information concerning land use problem areas in the watershed and examples of ***Best Management Practices*** (BMPs) that are in use. Finding information about the watershed and lake before volunteers begin will prevent repetition of information about problem areas that have been identified through other agency research.

3. Communicate and involve the watershed community.

Community support is critical to the success of a lake watershed survey. Before beginning the survey, talk with community ***stakeholders*** (area business people, lakefront property owners, and town officials) to let them know what is planned and to get their support. This also would be a great time to recruit volunteers for the survey!

Communication early in the process will educate and inform citizens about the project well in advance of the field survey. Community members may point out problem areas in the watershed before field volunteers do their work. Key members of the steering committee should work with landowners to identify sites and sources of technical assistance. Early awareness helps address citizens' questions and concerns. Landowner involvement should be emphasized when the project is discussed with members of the community. Misunderstanding about the survey objectives can be avoided when landowners are fully knowledgeable of the project.

Publicizing the survey process in advance, and holding public information meetings, will help ensure that the public understands the nature of the project and the need to access private land. Watershed association newsletters and Web sites can be used to publish information about the lake watershed survey. Regular communication with the public is the most effective way to avoid misconceptions about the project's purpose, findings, and recommendations.

Send a letter of explanation to landowners before the survey

Develop or obtain a mailing list for landowners in the lake watershed, and mail a letter explaining the survey. A one-page explanation of the survey objectives and the name and telephone number of contacts (e.g., a survey coordinator or watershed team leader) provides every landowner with an opportunity to ask questions about the project. These letters also provide another opportunity to ask for volunteer participation!

Organize public information meetings

Ideally, public meetings should be scheduled throughout the life of the project, and information about the survey should be available at town meetings.

Hold public information meetings to explain the purpose and procedures of the project to interested members of the watershed community. Invite the press to *all* public meetings and to attend volunteer training sessions. Send press releases to the local newspaper with progress summaries as the project proceeds. Local television reporters should be invited to attend public meetings. Make use of community bulletin boards in churches, schools, supermarkets, and public libraries to help raise awareness of the survey and its progress.

Speak with property owners during the survey

As a general rule, permission must be obtained before volunteer surveyors enter private land. Steering committee members should make every effort to make landowners aware of the project before volunteers begin the survey. Surveyors also should speak to property owners before entering their land to avoid potential conflicts or misunderstandings. This contact gives volunteers an excellent opportunity to explain the survey and educate the property owner. Information about how to approach landowners should be included in the training for field volunteers.

Landowners who do not wish to participate in the survey can notify the committee so their property will not be surveyed. However, not everyone will be aware of the project, and property lines are not always easy to determine. Town assessors maps can be checked, copied, and carried in the field to determine property ownership.

Leave information with property owners

If owners are not home when the survey is conducted, field volunteers should have a prepared statement about the survey along with a contact name and phone number. Volunteers should leave this information at the house and recontact the landowner another time. Do not survey any property without permission.

4. Involving agencies and organizations.

A number of local, state, and federal agencies and organizations can provide technical experience, guidance, and direction. Many of the members of these organizations become involved in their local lake associations and are willing to contribute their technical expertise for the lake watershed survey. The following are examples of the resources provided by organizations and groups that can assist in the survey process, both technically and financially. ***(See also Appendix D for contacts and Web sites for the following groups.)***

The Executive Office of Environmental Affairs watershed teams and local watershed associations can provide valuable help in all phases of the project. Technical expertise and materials, such as watershed maps, may be acquired through these groups. They should be among the first contacted.

Municipal governments should not only be informed about the survey but encouraged to participate. Clean lakes benefit communities in many ways. High property valuation around clean lakes result in higher tax revenues for cities and towns. Tourists, who are more likely to visit clean lakes and patronize local businesses, can increase local revenues substantially. Municipalities may be willing to cover the cost of materials required for the survey and expenses for professional oversight. It is essential that municipal officials be kept fully informed of the progress and findings of the project. They are likely to field questions from the public and they need to provide accurate information.

Conservation commissions can be an excellent source of information about the lake watershed. The commission may have already identified or mapped sensitive areas. Commissioners may be interested in participating on survey teams. They also may have aerial photos. Coordination with a local conservation commission in preparing the final project report may add credibility to the findings and recommendations of the survey team.

Regional Planning Commissions (RPCs) may be able to identify problem areas in the watershed and help organize information. RPCs may be willing to direct organizers to key people in the watershed towns. They may know of grants for the survey work and be willing to assist with the development of grant proposals for restoring problem sites identified during the survey.

The University of Massachusetts Cooperative Extension should be made aware of the project and approached for help. They work with agricultural producers in improving nutrient management and pesticide reduction. They also work to solve wellwater problems and conduct environmental education projects.

The Massachusetts Water Watch Partnership provides training and technical assistance to organizations that conduct water quality monitoring programs in Massachusetts. The partnership also can be a resource for finding funding opportunities. This group is affiliated with the University of Massachusetts at Amherst Water Resources Research Center.

The Watershed Planning Program in the Division of Watershed Management, Massachusetts DEP maintains water quality files for many Massachusetts lakes. They may have useful information on land use activities in your lake watershed, as well as extensive historical data about the watershed.

The Drinking Water Program in the Division of Watershed Management, Massachusetts DEP will have information on lakes and reservoirs that are active drinking water sources. DWP is conducting the ***Source Water Assessment Program*** to identify and map potential contaminant sources in Massachusetts drinking water sources. ***(see appendix E for more information)***

The North American Lake Management Society (NALMS) is a nationwide organization that creates partnerships among citizens, scientists, and professionals to further the protection and management of lakes. NALMS Web site at www.nalms.org has links to the New England chapter. Contact the New England chapter for information on workshops.

The Massachusetts Congress of Lakes and Ponds (MACOLAP) and ***LAPA-West*** promote and support the formation of lake and pond associations. Their objective is to preserve, protect, maintain, and enhance the environmental, aesthetic, recreational, and economic values of Massachusetts waterbodies.

The Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE) is a good resource for fish and wildlife habitat information. ***The Riverways Program*** assists with the organization of local watchdog and advocacy groups to protect waterbodies in Massachusetts.

The ***Natural Resource Conservation Service (NRCS)*** is a federal agency under the U.S. Department of Agriculture with regional offices in Massachusetts. The NRCS is familiar with erosion problems in many lake watersheds. Limited technical review and assistance in recommending BMPs may be available through NRCS, depending on staff availability and funding for other projects.

Lastly, qualified ***private consultants*** are available to assist with watershed survey projects. If a consultant is hired to work with the steering committee, the individual or firm should be thoroughly familiar with nonpoint source pollution issues, lake water quality issues, watershed land-use relationships, and the use of BMPs to mitigate nonpoint source problems. Hiring a consultant will add expense to the project, depending on the level of involvement.

5. Determine the survey schedule.

Establish a time frame for the survey. This ensures that surveyors are in the field during the best time of the year for seeing ***runoff***-related NPS problems. A schedule also provides volunteers with a deadline for returning field forms.

6. Find field volunteers to survey the watershed.

Field volunteers participate because they are concerned about protecting their lake and are willing to give their personal time to that effort. Volunteers reduce project costs and help educate and inform the community about the effects of watershed development on lake water quality. Because volunteers live in and represent the community, they are able to continue educating the public for years after the survey has been completed.

There are many ways to find people who are interested in being field volunteers. Many of the organizations listed below can be found in the yellow pages of a local phone directory, and on Web sites.

- Lake associations or shoreline property owner groups
- Conservation commissions
- Planning committees
- Youth conservation groups
- Student interns from college environmental studies programs
- Local community service organizations such as the American Association of Retired Persons
- Fish and game clubs
- Garden clubs
- High school students

Identifying financial and moral support for the volunteer network should always remain a priority for the steering committee. Financial needs for the volunteers can vary greatly, and there are a number of funding sources that can provide money for project materials and expenses. The most common expenses are telephone charges, mileage, photocopying of documents (topo maps and survey forms, for example), and buying and developing film.

Volunteers may need support beyond what they receive during initial training sessions. Interest and enthusiasm are critical to a survey project's success! Hard work and long hours devoted to the lake watershed survey deserve recognition. Events, small and large, should be planned to mark accomplishments and milestones of the volunteer team.

Consider the size of the watershed when gathering volunteer support

A **minimum** of 10 volunteers is needed for a lake watershed survey. The size of the watershed and the development density of the watershed will determine how many volunteer surveyors are needed. For large, densely developed watersheds, it may not be feasible to survey the entire watershed in one year. Try to estimate how much area can be covered, based on the size of the watershed and the number of volunteers available. Involve enough volunteers to visit all developed property, roads, and undeveloped areas.

Tell field volunteers what to expect

Each volunteer should make a **minimum** time commitment of one day for training and two days in the field. They should expect to provide carefully written, photographed, and illustrated documentation of the problem sites found. Volunteers should understand the importance of accurate and consistent reporting of information.

Volunteers should be made aware that it may be necessary to visit certain sites during inclement weather conditions. Specific site problems that will be found in different weather conditions should be covered during the field volunteer training. Following a review of the volunteers' field data, they may be asked to revisit sites to verify observations, particularly if vital information is missing from the survey forms. Revisiting sites also is useful as a quality assurance and control measure. One or two volunteers should be designated as group coordinators. They should be responsible for relaying information from the steering committee to the field volunteers.

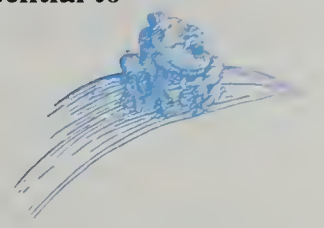
Part of the process of identifying sources of phosphorus and sediment should be done during runoff-producing storms, if possible. Volunteers should be aware that "windshield surveys" (surveys done from the seat of a car) will not produce the detailed information needed. They may have to track runoff for considerable distances from the lake to locate the sources of pollution.

7. Arrange for training sessions.

Who should train volunteers?

Training sessions should include a presentation on the goals and objectives of the project. The reasons for monitoring, the history of the watershed and lake, uses of data collected, and how the project will benefit the volunteers, the community, and the state should be covered in the first meeting. There should be an overview of the survey procedures, preferably with a slide presentation. A trial run of proper methods of surveying should be done by the trainer while in a classroom setting. The training session also should include the distribution of any equipment and an explanation on how to use the equipment. Volunteers should be encouraged to provide an evaluation of the training session to the training team.

Volunteer training is essential to the success of the lake watershed survey. Become a dynamic lake surveyor through training! Enthusiasm is catching!



The second part of the training involves a field assessment of actual problem areas in the watershed. This training should emphasize detailed and accurate documentation. Joint visits to a few sites will promote consistency in field data collection and reporting. Volunteers will be given an opportunity to practice what they have learned.

Fundamentals that volunteers should learn

Volunteers should know that there are two basic questions that need to be answered in reporting each problem: Where is the problem? What is the problem? Field survey forms that do not answer these two questions can slow the process and add expense to the survey.

Prepare topographic maps for use in the training session

The lake watershed should be outlined on USGS 7.5-minute topographic maps. Copies of USGS topographic quad maps are available from MASS GIS on-line ***(see Appendix C)*** or call 800/USA-MAPS. Another good source of topo maps can be found at www.topozone.com. Many copy centers now have map copiers that will reproduce a USGS map, but the copy will not be in color. If time and cost allow, copy or trace watershed boundaries directly onto original USGS maps to have color-coded topographic information. General guidance for reading topographic maps can be found in Appendix C. Distribute and review this guidance with the volunteers during training.

Divide the watershed into sections

Prior to the training session, divide the watershed into clearly defined areas. Each area should be small enough so that two or three volunteers can cover it in approximately two days, or 7-8 hours. Establish area boundaries along features that are easy to locate, like roads and streams. ***(See next page for an example map.)***

Establish teams of two for each area

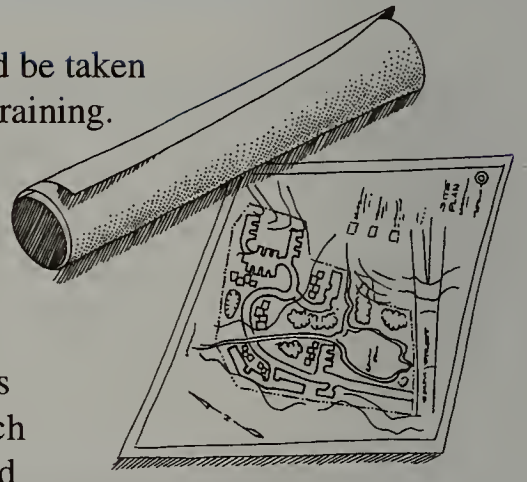
Volunteers should work in teams of two for several reasons: safety, to share ideas about site evaluations, and to help each other fill out data sheets consistently and accurately. It is also easier to obtain follow-up information on a specific site when more than one person can be contacted.

Give volunteers lake watershed survey data collection forms

Appendix A contains a sample watershed survey data collection form used by the Massachusetts WaterWatch Partnership. There are data collection forms designed for use with this survey and will be part of the lake watershed survey training for volunteers.

Give the volunteers practice

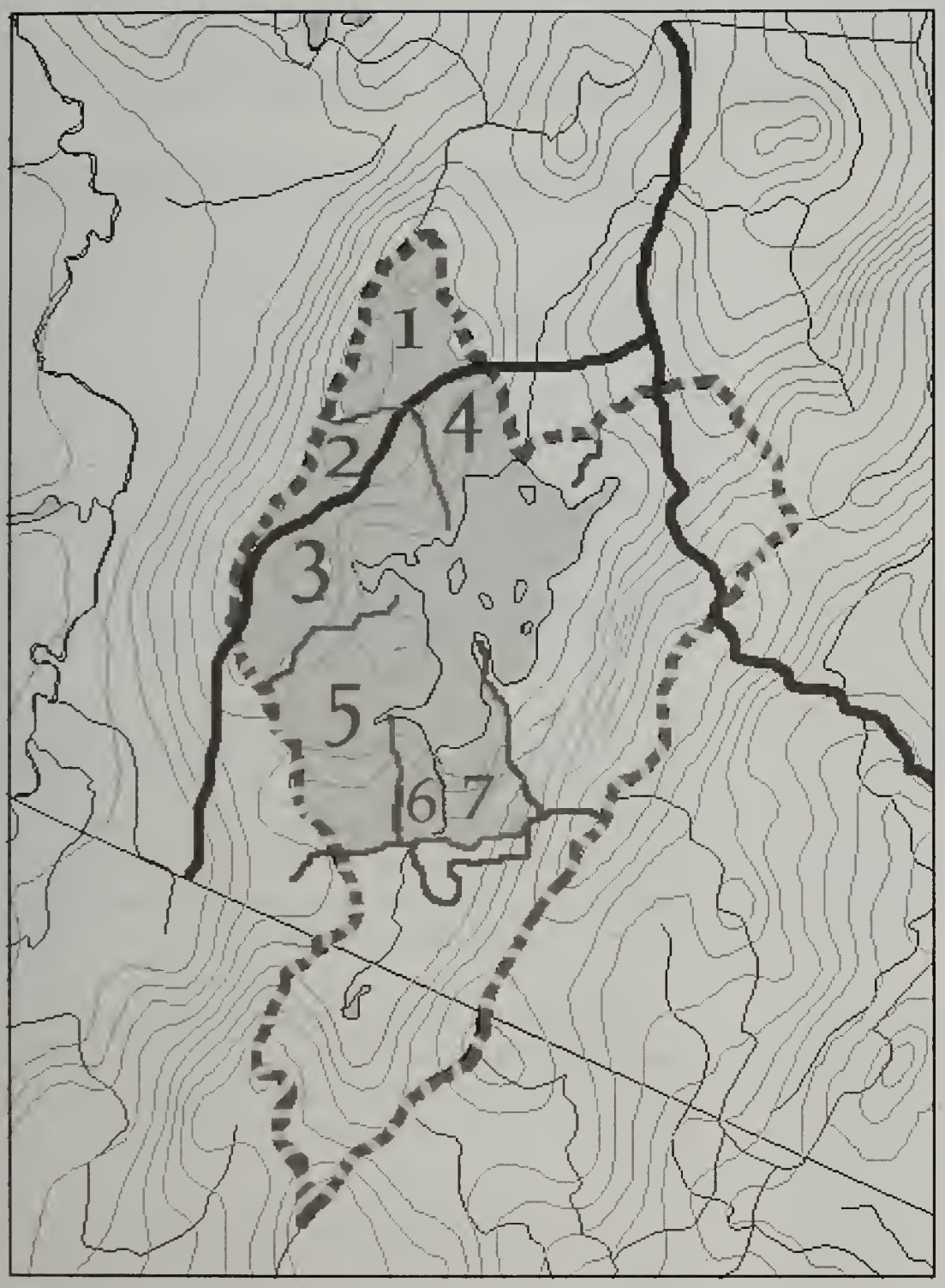
Volunteers should be taken into the field during training. Representative sites should clearly illustrate types of problems volunteers need to recognize, as well as good practices that can be found, such as existing buffers and landscaping with native plants. Sites can be defined as any problem area that can reasonably be described on the survey form. Include a variety of land uses such as open space, forest, water and marsh, agricultural (cultivated and pasture), and developed (urban and residential). Visit sites where BMPs are being used to emphasize the difference between stable and unstable land uses. Contact property owners to inform them that their sites provide good examples, ask permission to access their property, and encourage their participation in the training.



In addition to seeing typical NPS problems, have the survey volunteers participate in a problem-solving exercise. Ask them to locate and identify different land-use sites within a specific area.

Volunteer Training Issues to Cover:

- What is a watershed and how does it work?
- The goals of the survey.
- Tools for watershed management.
- What are stormwater runoff and nonpoint source pollution? How do they affect lake water quality?
- How soil erosion and phosphorus affect lake water quality.
- Lake ecology and how changes to the lake's ecology reduce recreational enjoyment.
- How changes in water quality affect the local economy.
- Safety in the field.
- How to read topographic maps.
- How to fill out survey forms.
- Methods for keeping accurate and detailed documentation.
- Examples of typical erosion problems (photos and slides as well as visits to actual sites).
- How to discuss the survey with landowners (i.e., public property rights or trespassing issues.)



Assigning Areas in the Watershed

The watershed should be divided into areas that are clearly defined by boundaries, such as roads or streams. The areas should be small enough that volunteers can cover the majority of the area in approximately two days.

This example shows clearly delineated boundaries using major highways, minor connecting roads, and existing waterbodies. Field volunteers can easily navigate through their area by using the boundary lines that are created naturally.

More information on reading and finding your way through topo maps can be found in Appendix C.

Legend

- *Sub-Basin*
- *Major Road*
- *Minor Connectors*
- *Waterbody*
- *Assigned areas*

This topographic map shows the Bare Hill Pond sub-basin in the Nashua Watershed. Bare Hill Pond is located in Harvard, MA.

8. Send volunteers out to conduct the survey.

Plan ahead

Even if articles about the project have previously been published, print a reminder before the survey begins. Issue a brief press release to the local papers describing the project and the schedule for the survey just before volunteers go into the field.

Stay on schedule

The survey should be conducted according to a schedule set by the survey team. The public will be expecting volunteers to be surveying the watershed within the period of time discussed in newspaper articles. Staying on schedule also allows time for follow-up if there are questions concerning the volunteer findings.

Provide support for volunteers in the field

If the trainers and volunteers feel additional help is needed, consider meeting with the volunteers at a predetermined location on the first day of the survey. This allows volunteers to check back with the advisors during the day with questions, and it allows the team to review survey forms to ensure that information is being properly documented. This can save a lot of time after the volunteers have finished and are less available.

9. Review field data for preliminary summary.

Immediately after the lake watershed survey is finished, all survey information should be reviewed by members of the survey group to verify that the survey forms have been properly completed and all sectors evaluated.

The team will evaluate the accuracy and thoroughness of the documentation. Individual problems that have been identified will be prioritized. This process can take a few days or several weeks, depending on the number of problems that are identified.

If the survey information is incomplete, the volunteer coordinator should contact the volunteers *immediately* to ask for the missing information, which might require another field visit. Sites also may be checked with aerial photographs, where feasible. Contacting the volunteers soon after they have completed their work may save time that could be needed to locate poorly defined problems.

Throughout the lake watershed survey, the data being collected should be monitored as it comes in. Volunteers should be encouraged to ask questions about the process as they fill out the survey forms.

The data should be compiled from the field survey forms. A review of this data will help prepare a strategy to address specific site problems, which will need to be prioritized. High priority sites will not always be the focus of the strategy. The cumulative effect of correcting many lower priority sites may have greater benefits and be easier to address. These sites may be repaired at lower costs. In Section 5, a method is laid out for setting objectives and recommending activities to correct erosion and sedimentation problems.

Protection of the lake is an ongoing process. The steering committee's plan should develop long-range goals and recommendations for the future to sustain the interest and involvement of the watershed community.

Steps for a Lake Watershed Survey—Field Volunteers

Section 4

What's Here?

Decide When to Survey
Plan to Talk to Landowners
Conducting the Survey
FillingOut the Survey Form

1. Decide when to survey.

At this point, field volunteers have training, topographic watershed maps, and blank survey forms. Volunteers are ready to begin surveying the watershed. Begin surveying the assigned section of the watershed as soon after the training as possible. Ideally, the survey should be conducted within a week or two of training.

A watershed survey can be conducted at any time. However, there are advantages to conducting a watershed survey in the spring, between March and May, because:

- The ground is likely to be ***saturated*** with water due to spring snowmelt. Under these conditions, ***stormwater runoff*** from rainstorms will be at a maximum (phosphorus and sediment in runoff from spring storms often represents a large percentage of the total annual phosphorus load to a lake).
- Eroded areas will be more visible due to the absence of vegetation.
- No spring maintenance on roads will have taken place, so problems will be more obvious than after roads have been regraded and repaired.
- Time will remain for the follow-up team to complete the project during the summer months.

Because about 90 % of erosion occurs during heavy storms, it will be easier to see runoff associated with erosion when a survey is done during or just after a storm. However, it will be more convenient to plan and conduct the first survey on a day that has been scheduled in advance. During the survey, look for brown or ***turbid*** (cloudy) water in road ditches, swales, brooks, and streams. This is an indication that silt and other phosphorus-bearing soil particles are present. Severe erosion problems, such as gully erosion, ditch and road washouts, and undercutting of streambank slopes from running water or in areas of heavy shoreline wave action, are obvious in dry weather.

2. Decide where to start.

Before going into the field, become familiar with the assigned section of the watershed on the topographic map of the watershed. Locate roads and watershed boundaries, and decide where to begin. The ability to read maps is a skill necessary for locating and documenting sites. Practice reading topographic maps before doing fieldwork. ***(A guide for reading topographic maps is in Appendix C.)***

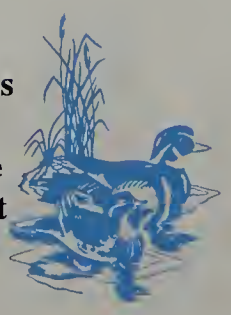
Starting at the low point—the lake itself—and working up the watershed is usually most efficient. **The most environmentally sensitive area is within 1000 feet of the lake and its tributaries.** Access the watershed via roads. Begin near the lake at one end of the road; work within the assigned area of the watershed. An orderly progression through the watershed works well for documenting and recalling sites.

3. Gather materials for the field.

- ☐ Clothing for foul weather, including rain gear, hat or hood, gloves, comfortable boots, warm sweater, and socks.
- ☐ Survey forms, topographic maps of the watershed, clipboard and pencils; if possible, stored in a sealed plastic bag or a field clipboard designed to shield contents from the weather.
- ☐ Camera, film, and fresh batteries—the saying "a picture is worth a thousand words" is especially true when documenting watershed problems.
- ☐ A 50-foot tape measure to measure areas of the site and distances from landmarks (or measure your pace so you can estimate distances by "pacing" it out).
- ☐ Life vest, in case you work around large streams with high-velocities.
- ☐ Flashlight with fresh batteries (useful for checking ***culverts*** and as a safety precaution).

4. Prepare to be safe in the field.

This section is set up as a series of checklists that volunteers can use to prepare and conduct the survey.



- ☐ Always work in teams of two or more.
- ☐ Be sure someone at home knows where you are.
- ☐ Dress appropriately.
- ☐ Have a first-aid kit, and tick and insect repellent available.
- ☐ Always use a map.
- ☐ Bring a cell phone.
- ☐ Walk only where footing is safe — do not compromise your safety to gain access to a difficult area.
- ☐ Use caution walking near roads, a rocky or steep shoreline, or on slippery rocks.
- ☐ Know how to recognize poison ivy.
- ☐ Bring water and snacks.
- ☐ Heed "beware of dog" signs.
- ☐ When working around large streams with high velocities, wear a life jacket.
- ☐ After field visit is over, check for ticks.

5. Talk with landowners.

- ☐ Knock on the door, introduce yourself, and explain the survey. This is an excellent opportunity to educate the community.
- ☐ Take along handouts to give to landowners. Handouts explain the watershed survey work *(see Appendix A.)* If no one is at home, leave a handout explaining the project.
- ☐ Be clear about the purpose of the survey:

➢Volunteers are trying to identify problems that may be impacting the lake.
➢Volunteers are finding the pathways in which stormwater carries soil and pollutants to the lake or tributary streams.
➢Volunteers and technical teams are developing solutions to the problems identified and are creating an action plan detailing solutions.
➢Volunteers are raising public awareness about the effects of polluted runoff on the lake and building support in the community for local watershed management.

- ☐ Be prepared to respond to uncooperative people. If the property owners do not wish to have their property surveyed, leave them literature and move on to the next site. Confrontations are unnecessary.

- ☐ Always respect the property owner's wishes, regardless of the situation. If a volunteer suspects a serious problem exists on an inaccessible site, note it on the survey form and notify the DEP Regional Office (Appendix D), so that the site can be visited later.

The volunteers' presence will generate interest. People may question what volunteers are doing, and why they are going onto private property.

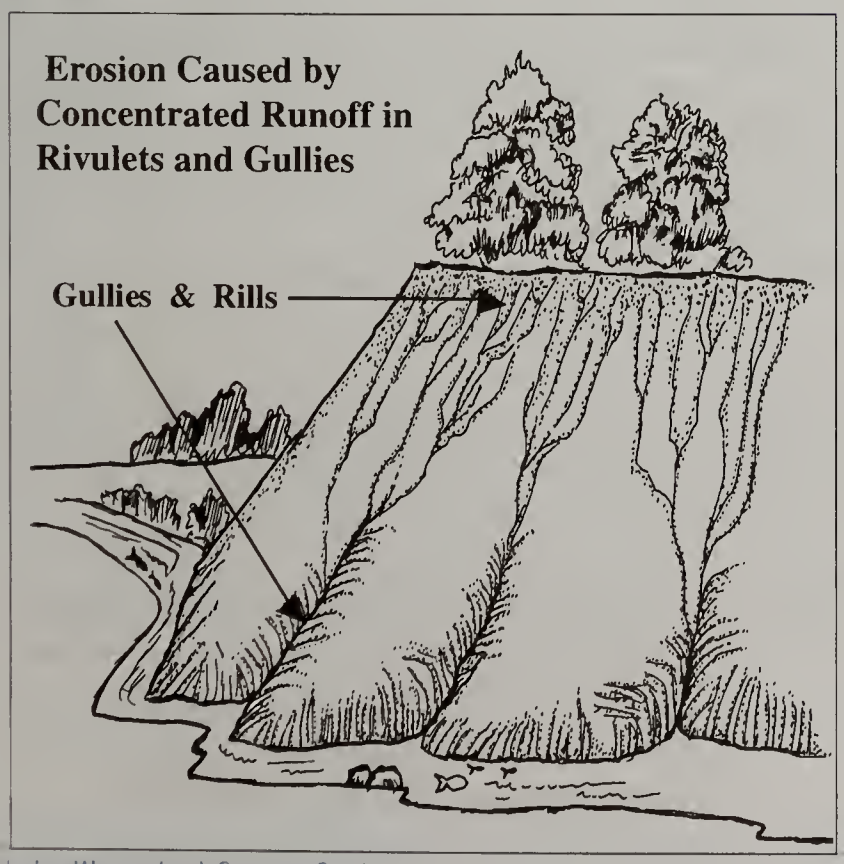
6. Who should be contacted for questions?

Even with training, questions will come up throughout the survey. Look for answers in Appendix B, Frequently Asked Questions, and contact the following people:

- ☐ Your partner.
- ☐ Steering committee chair.
- ☐ DEP Nonpoint Source (NPS) Coordinators (Appendix D) are available to answer questions — just a phone call away.

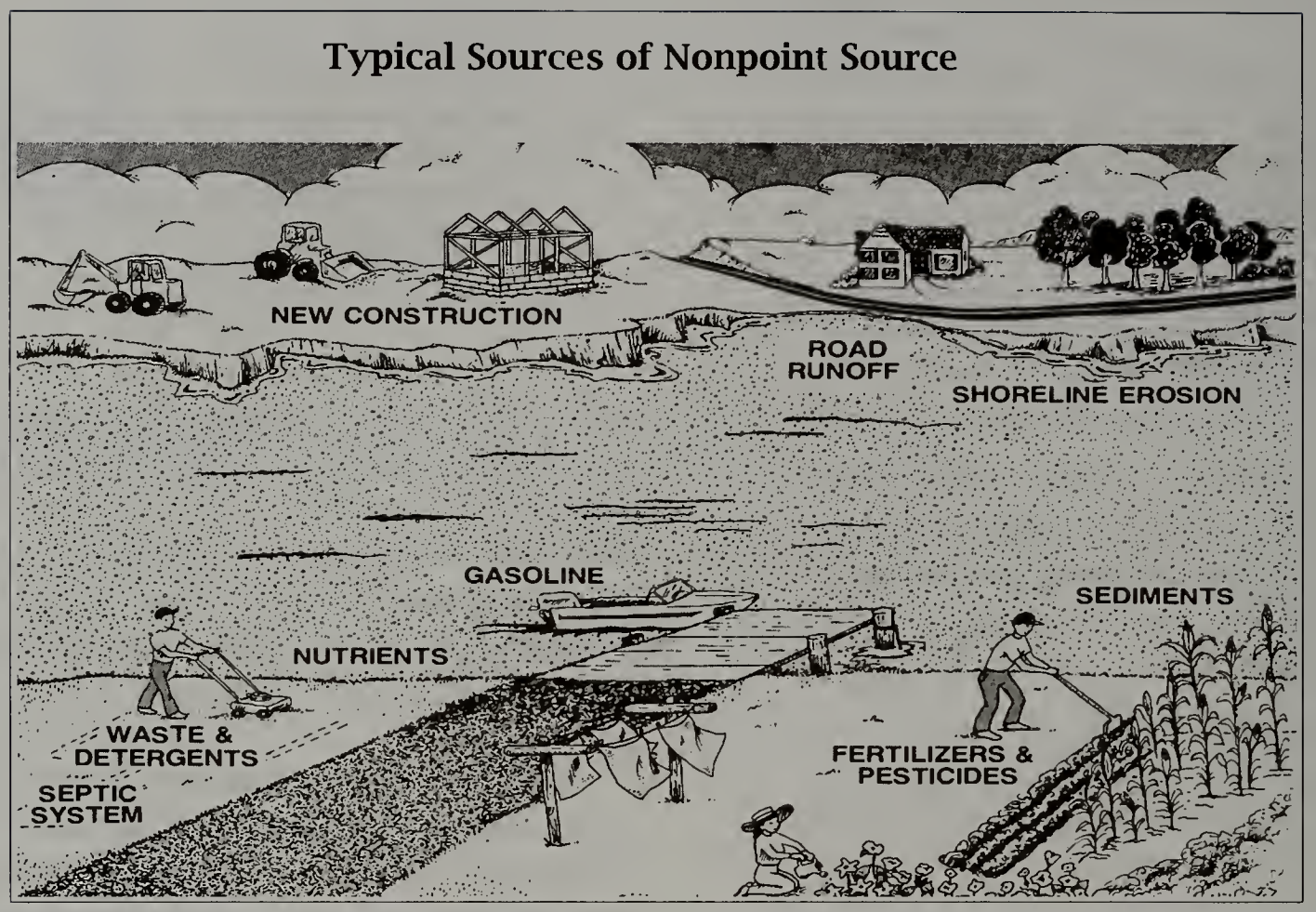
7. Conducting the survey— What to look for in the field.

Regardless of land use type, volunteers will be looking primarily at the pathway for stormwater runoff. Is the runoff flowing directly to a stream or lake? How close is the erosion problem to the lake or stream? Is it entering a channel or ditch that flows to a stream or lake? Does runoff flow to a vegetated buffer before it reaches a stream or the lake? How well is runoff distributed throughout the buffer? Does the runoff spread over the ground, or does it flow through the buffer in a channel? Are there steep slopes at and below the site that might cause runoff to pick up speed and erode channels?



Volunteers should look for, and record, the approximate distance from the site to a lake tributary, an ***intermittent stream,*** a road ditch, or the lake. Road ditches often transport contaminated runoff for hundreds of feet before flowing into a brook. It may be necessary to follow runoff for a considerable distance before determining whether runoff from the problem site reaches the lake.

Remember, during a storm or right after, it's easier to see evidence of erosion such as turbid water. However, clear runoff may still be a concern. Therefore, document any runoff to a ditch, stream, lake, or wetland. Also learn to recognize sediment deposits, which accumulate or mound near stream channels and shorelines, downstream of areas with eroding soil. Look for activities that alter or remove streambank, shoreline, and natural vegetation. These activities cause open areas to be more vulnerable to erosion.



Look closely for land disturbances that may be causing changes in lake water quality or increasing sediment transport, such as:

Land Disturbances–Examples:

- ☐ Bare soil, uncovered/unfenced piles of soil.
- ☐ Erosion, such as ***gullies and rills.***
- ☐ Undercut or slumping banks or slopes.
- ☐ Cloudy or discolored water or runoff.
- ☐ Green scum, oily sheen, or floatables on water.
- ☐ Sediment deposits/build up in waterbodies or pipes.
- ☐ A defined pathway of runoff from the site.
- ☐ Pipes/culverts with runoff, stains, or odors.
- ☐ Animal manure, trash, vehicles, or waste storage near waterbodies.
- ☐ Altered and paved areas near waterbodies–absence of ***vegetated buffers.***
- ☐ Slopes of 7% or more on topographic maps (***See Appendix C***).
- ☐ Absence of erosion and sediment barriers around disturbed areas, such as hay bales and ***silt fences.***
- ☐ Absence of check dams in ditches or swales.

Look closely at all land uses in the survey area, particularly the following:

More information on land uses follows the list.

Land Uses–Examples:

- ☐ Construction sites: disturbed areas and waterbodies.
- ☐ Residential areas: driveways, shoreline, paths to shoreline, and lawns, (especially very green lawns).
- ☐ Roads (town, state, and private): ditches, shoulders, banks, stream crossings.
- ☐ Agricultural areas: cultivated fields, pasture/ open land, manure storage areas, animal stream crossing, animal grazing.
- ☐ Urban, commercial, and industrial areas: parking and vehicle maintenance areas, dumpsters and waste storage areas near waterbodies; piped drainage ways to streams and wetlands.
- ☐ Logging operations: trails, roads, stream crossings, logging yards, cut areas.

Field volunteers will find other land uses, such as landfills, parkland and open space, and gravel pits. Although these are not the primary land uses described in the guide, discuss these sites and how to proceed with the DEP NPS Coordinator.

Construction Sites

Soil can erode from excavated or filled areas during and after construction of new buildings, additions to existing structures, foundations or footings, and during landscaping projects. Soil erosion from construction sites is usually obvious. Small gullies or channels, called rills, appear on the surface of bare soil where soil particles have been carried away by rain or snowmelt. These channels do not have to be very wide or very deep to cause downstream problems. The larger the exposed area and the steeper the slope, the greater the potential for soil erosion. Areas that are not replanted following construction can be ongoing sources of phosphorus and sediment to a lake.

Erosion of soil from construction projects can be greatly reduced by stabilizing the soil surface with erosion controls. Erosion controls can preserve topsoil, which reduces landscaping costs. A wide range of erosion controls are available, such as mulch, blankets, plastic sheeting, and sod. These ***erosion controls*** must be installed properly and maintained in order to be effective.

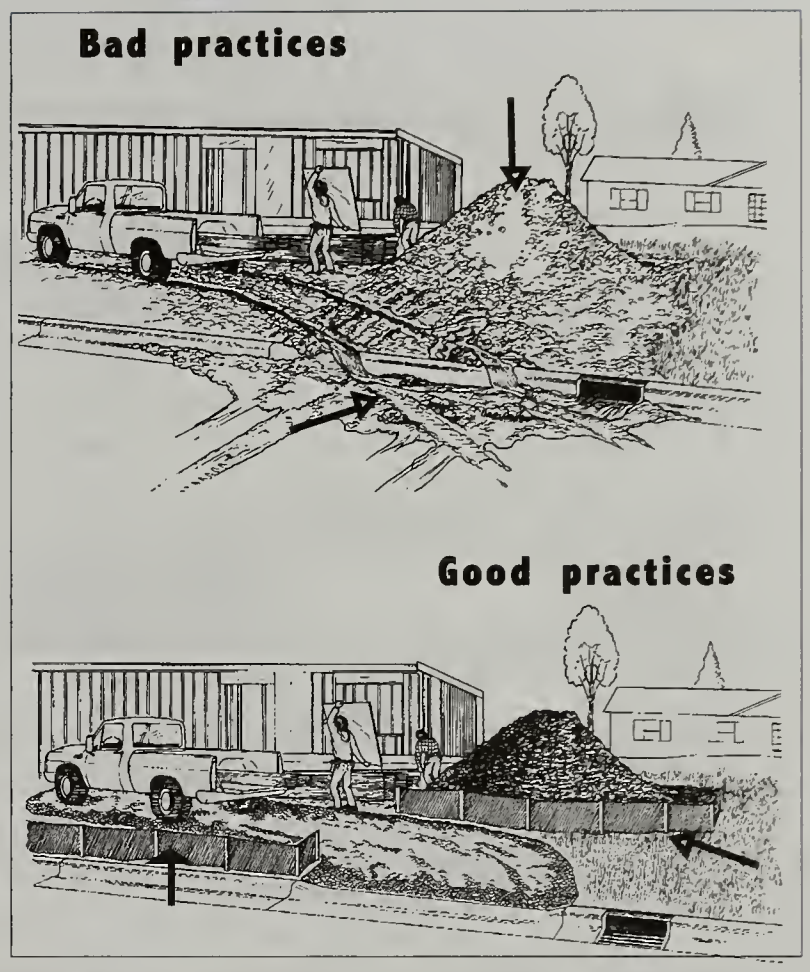
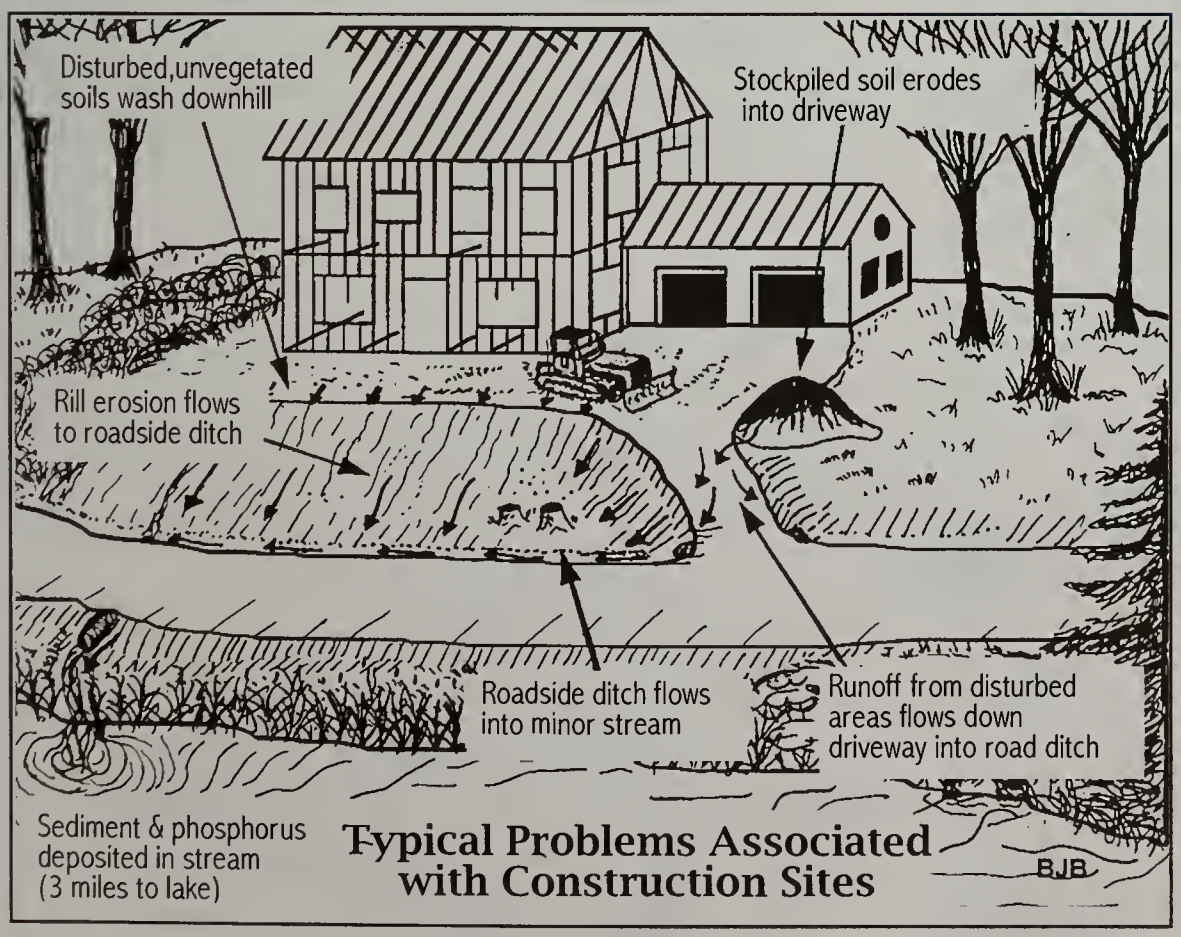


Figure: With and without erosion control fencing at a construction site.

Construction Sites - Examples:

- ☐ Exposed soil and erosion.
- ☐ Alteration to drainage pathways or alteration near waterbodies.
- ☐ Absence of erosion controls.
- ☐ Evidence of erosion, such as gullies or rills (illustration on page 35) on the surface of the soil.
- ☐ Cloudy or discolored water in ditches, streams, wetlands, or lake.
- ☐ Sediment build up in ditches, streams, wetlands, or lake.
- ☐ Construction on steep slopes.
- ☐ Check local permits for an erosion and sediment control (ESC) plan.
- ☐ Erosion controls such as silt fences and hay bales that are not working (not holding the soil on site, or not anchored into the ground).


Disturbed,unvegetated soils wash downhill
Stockpiled soil erodes into driveway
Rill erosion flows to roadside ditch
Roadside ditch flows into minor stream
Runoff from disturbed areas flows down driveway into road ditch
Sediment & phosphorus deposited in stream (3 miles to lake)
Typical Problems Associated with Construction Sites
BJB

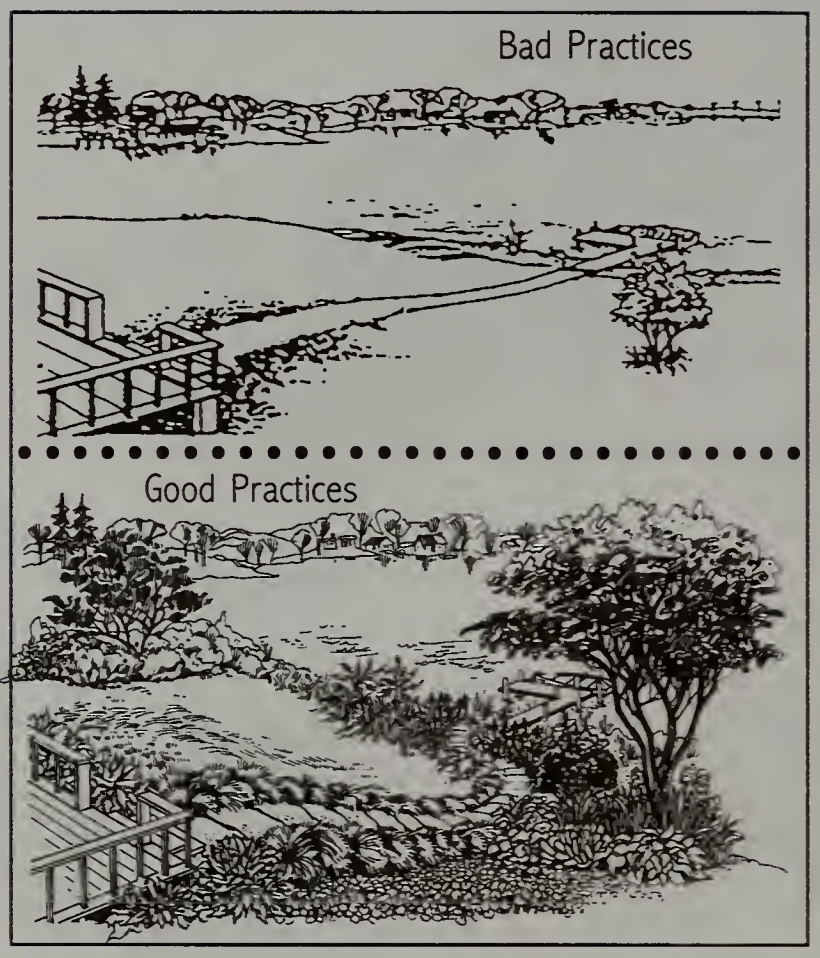


Figure: Lake residences with and without vegetated buffers on the shoreline.

Residential Areas

Residential areas are a source of runoff pollutants. Of concern are eroding soils, shorelines, or streambanks; poorly vegetated lots and improper use of fertilizer and pesticide in landscaping practices; effluent from poorly maintained or failing septic systems; illicit sanitary connections to storm drains; pet waste; and concentrated runoff from roofs, driveways, lawns, and other hard or impervious surface areas.

Lakes can benefit greatly by keeping a vegetated buffer area between structures and the lake, or along pathways to the lake (ditch, stream, and wetlands). Vegetated buffers filter out pollutants from runoff before they reach the lake. Vegetation also provides habitat and shade for animals that depend on the lake for survival.

Residential areas - Examples:

- ☐ Areas of bare soil.
- ☐ Turbid (cloudy) water.
- ☐ Evidence of erosion on driveways or other areas, such as gullies or rills on the surface of the soil, or sediment accumulation in ditches and streams.
- ☐ Bank instability—bare soil, slumping, or undercut banks.
- ☐ Removal of vegetation near shoreline, resulting in increased vulnerability to erosion.
- ☐ Unstable, eroding access points or paths to the lake.
- ☐ A direct pathway for runoff to reach the lake.
- ☐ Absence of vegetation or vegetated buffer.
- ☐ Evidence of septic system problems— lawn with green patch, soggy or wet lawn, and/or sewage odor.
- ☐ Lush lawns.
- ☐ Pet waste.
- ☐ Improperly stored trash (e.g., trash barrels or dumpsters) or organic debris (grass clippings, leaves, compost) near a waterbody.

Roads

In many watersheds, roads represent a significant percentage of impervious areas and problem sites. Poor design, location, and maintenance of paved and unpaved roads can contribute to chronic erosion problems. Steep slopes and unstable banks adjacent to roadways are prone to erosion. Without routine grading and the addition of new gravel on gravel road surfaces, these surfaces tend to erode. In addition, road erosion problems occur in areas of increased development, which contributes runoff in excess of the design capacity of the road drainage system.

Road drainage ditches erode when designed improperly, when not stabilized after construction, and when not maintained. Erosion also can occur around culverts that are undersized or installed without sidewall or ground stabilization measures at inlets and outlets. When ditches and culverts are not working properly, a road surface can wash away.

During dry weather, pollutants from cars and trucks accumulate on roads. Sediment, metals, oil and gas residues, and other materials, including phosphorus are picked up by stormwater from roads. Gravel and paved roads are designed to shed stormwater. Stormwater runoff from roadways concentrates in ditches, which often discharge directly into streams and waterbodies.

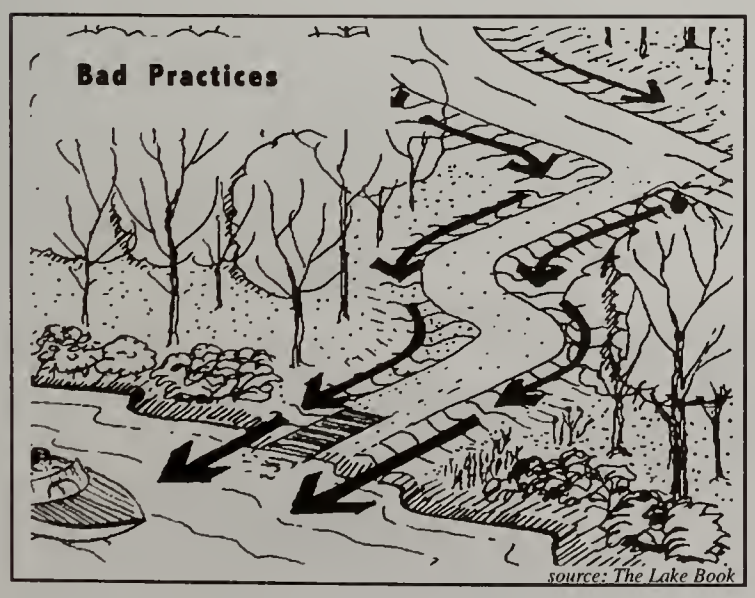


Figure: Road runoff discharging directly into the lake.

Roads - Examples:

- ☐ Roads located close to streams, lakes, or wetlands.
- ☐ Absence of vegetation or buffer between road and waterbody.
- ☐ Roads located on steep slopes.
- ☐ Washouts and crumbling pavement.
- ☐ Ditch, culvert, or pipe washouts, undercutting, or gullies and rills along sides and bottom of road or ditch.
- ☐ Exposed soil in ditch channel.
- ☐ Ditches that are long without discharge points into vegetated areas.
- ☐ Ditches, culverts, or pipes that empty runoff into streams, wetland, or lake.
- ☐ Erosion around inlets and outlets of culverts.
- ☐ Sediment buildup in lake or stream channel below culvert.
- ☐ Washed out or damaged culvert.

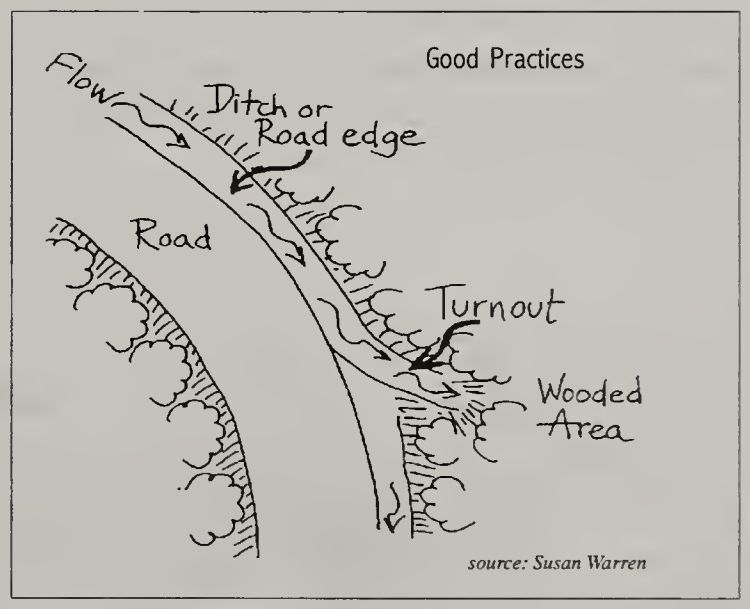


Figure: Road runoff discharging to vegetated area before draining to the lake.

Agricultural areas

Agricultural land uses, while not prevalent, can be significant sources of phosphorus and sediment, as well as other pollutants that are transported by stormwater. Most tilled fields experience at least some erosion problems, particularly in spring. Drainage alterations to fields and yards are very common, and can concentrate the runoff into ditches or streams. Eroded soil from cropland may contain very high levels of phosphorus, pesticides, and herbicides.

Manure spread on frozen fields during late fall, winter, and early spring is easily washed away to a ditch, tributary, or lake by rain and snowmelt. Manure-handling systems, if not properly designed and used, leak liquid wastes containing high concentrations of phosphorus and bacteria.

When livestock graze close to a lake shoreline or stream, animal waste, which includes ***nutrients*** and ***biological contaminants*** such as bacteria and viruses, may wash toward the water during wet periods. Streambanks and shoreline areas also may break down and erode if animals are not fenced, and overgrazing can increase soil loss.

Agricultural areas - Examples:

- ☐ Bare soil.
- ☐ Tilled fields where no buffer exists between area and stream, lake, or wetland.
- ☐ Fields close to road ditches.
- ☐ Turbid water in ditch, stream, wetland, or lake.
- ☐ Farm animals grazing in or directly adjacent to streams, lakes, or wetlands: broken down stream banks and/or shoreline, stream widening, disturbed soil adjacent to stream.
- ☐ Manure spreading during periods when the ground is frozen, or where runoff can reach the stream or lake.
- ☐ Leaking storage areas and storage areas that are not enclosed or covered.

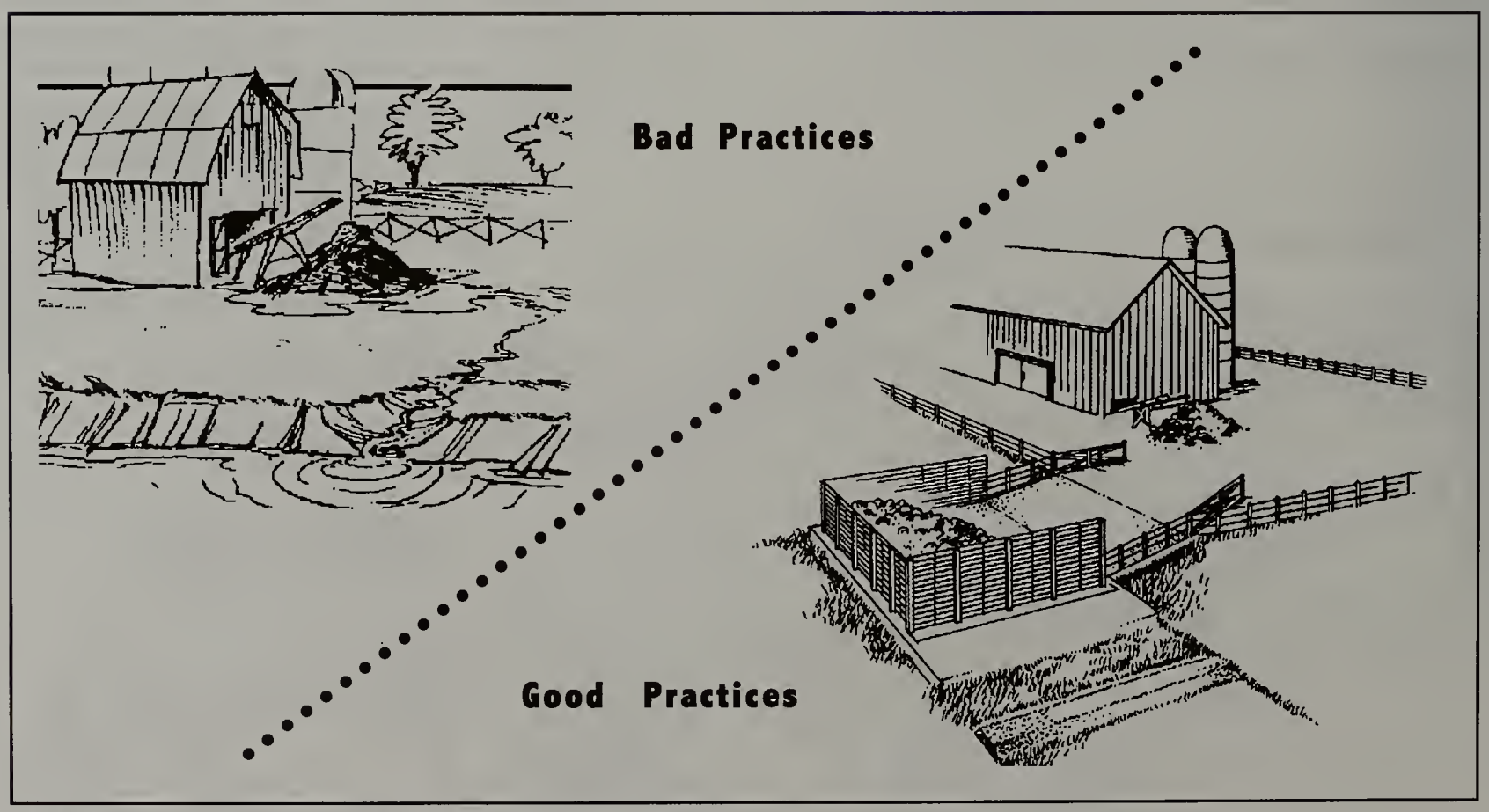


Figure: Feed lot and manure storage should be contained or covered.

■ Urban areas

Urban areas typically have a mosaic of land uses to support thriving communities. In addition to homes, businesses, and commercial development, urban areas are defined by a wide variety of land uses such as parkland, gas stations, cemeteries, roads, railroads, and utilities.

Urban stormwater runoff is characterized by increased volume and velocity, which can cause severe erosion and flooding damage downstream. More stormwater runs off urban areas because there is more ***impervious pavement.*** Generally, natural drainageways are not large enough to handle increased runoff associated with urbanization. Consequently, urban runoff, which may contain high concentrations of phosphorus and other pollutants, causes streambanks to erode, while depositing sediment, phosphorus, and other pollutants into lakes.

In urban areas, much of the runoff also is conveyed underground by a storm drain system, which may consist of street gutters, storm drains or catchbasins and sometimes detention ponds, treatment structures, or constructed wetlands. Typically, the ultimate discharge of stormwater is to a surface waterbody, but this may not be obvious. Thus, the watershed survey work in an urban area should start with a visit to the municipal department of public works in order to learn more about the storm drain system, and to review storm drain maps, if available, to locate discharge points in the watershed. The town or city engineer also may be able to identify private land uses that discharge stormwater to the municipal drainage system, and explain the maintenance schedule for cleaning the municipal drainage system and street sweeping.

Urban areas - Examples:

- ☐ Street drains, storm sewers, and pipes that discharge directly to streams, lake, or wetland.
- ☐ Street drains and catch basins with sediment or waste material.
- ☐ Eroded or undercut banks due to increased stormwater volumes and flows.
- ☐ Green scum, oily sheen, or floatables on water.
- ☐ Cloudy, discolored, or smelly water in ditches, streams, wetland, or lake.
- ☐ A defined or eroded pathway of runoff from the site.
- ☐ Sediment buildup in stream channel below pipe or along roadside.
- ☐ Damaged or eroded pipe or culvert outlets.
- ☐ Absence of vegetation or vegetated buffer near waterbody.
- ☐ Altered and paved areas near waterbodies.
- ☐ Lush lawns.
- ☐ Pet waste.
- ☐ Improperly stored trash (e.g., trash barrels or dumpsters) or organic debris (grass clippings, leaves, compost) near a waterbody.
- ☐ Manure, trash, vehicles or waste storage near waterbodies.

Figures: Runoff directly from paved areas into streams during summer months increases water temperature, which threatens cold water fisheries. Vegetated buffer zones correct the problem.

Forestry operations

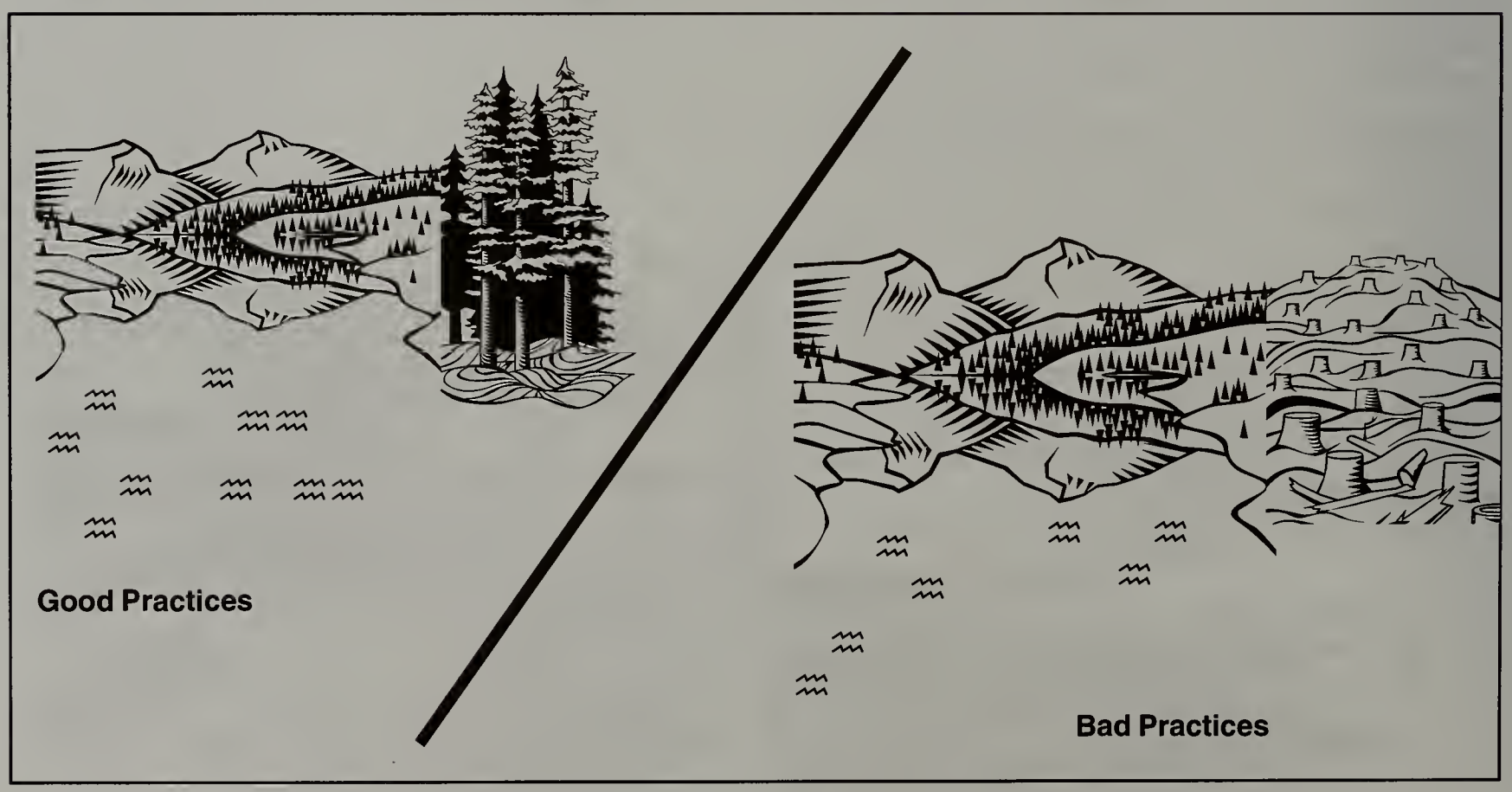
Some of the problems typically associated with logging operations, like logging yard erosion and runoff from skidder trails, are easy to detect. More subtle problems, such as stream bank scouring from increased runoff may be overlooked. Poorly located and constructed logging roads, improperly designed stream crossings, heavily cut woodland buffers along streambanks, areas of exposed soils in logging yards, and brush and slash placed in streams can all harm stream and lake water quality.

Runoff from a heavily logged site can increase in a very short time, producing severe soil erosion in the area that has been cut, and along streambanks and downstream property. Skidder trails are often deep enough to redirect the course of small streams. If this occurs, soil can erode from the new stream course for several months or longer, until the new stream bed has stabilized.

Forestry operations- Examples:

- ☐ Road surface and ditch erosion.
- ☐ Ditches that empty runoff to streams or channelized flow.
- ☐ Unstable culverts, roads close to streams.
- ☐ Areas where skidder trails cross streams, causing erosion of stream bank and redirecting runoff.
- ☐ Erosion of culvert inlets and outlets.
- ☐ Turbid water or sediment in stream.
- ☐ Heavily cut woodland buffers along streams.
- ☐ Bare soil.
- ☐ Gullies and rills.
- ☐ Poor design of logging roads.

Figures: Logging operations should maintain a buffer zone of vegetation along waterbodies.



8. Filling out the Lake Watershed Survey Form—Checklist:

- ☐ **Fill out the survey form completely. Be sure to put the same number on the corresponding site map, form, photographs, and drawings.**
  (See Appendix A for a sample watershed survey form. Survey forms will vary from watershed to watershed, and the information within the form will reflect the conditions found in your watershed.)

- ☐ Fill out one survey form for each site within the assigned area. If the entire site is not surveyed, explain why and estimate the percent of the area that was not covered.

- ☐ Fill out all forms in the field, as work is done. Do not rely on an after-the-fact memory.

- ☐ Mark the site on your topographic map using the site number. Take one or two pictures and label them with the site number and surveyor's name. As photographs are taken, write the exposure number from the camera and the site description on the survey form. When the film is developed, this will ensure that the corresponding photos will be submitted with the forms.

- ☐ Draw a site diagram. Use easily identifiable landmarks in the drawings and provide information on distances and estimated slope. Sketch an area map to show where the problem is. ***(See the sample form in Appendix A.)***

- ☐ Provide details, such as road names, telephone pole numbers, and house numbers. In large watersheds or remote areas, use a global positioning system (GPS), if available.

- ☐ Record weather information from the last 48 hours on the survey form. For instance, was there a recent heavy rain storm or has it been very dry? Weather is an important factor in the way pollutants move from the watershed to the lake.

- ☐ Estimate the dimensions of the problem area. The approximate width and depth of runoff channels and exposed soil areas are important in assessing the severity of a problem site.

- ☐ Note whether the problem is connected to a stream or lake. During the initial survey, carefully assess the cause or causes of the erosion or sediment problems. This is essential to correcting problems and setting attainable goals.

- ☐ Document why you identified a particular site. This information will help in the follow-up analysis and provide insight into the nature of (and solution to) the problem.

- ☐ Proper documentation is critical to the watershed survey's usefulness and success. Any follow-up work may take place during another season when the ground may look dramatically different from the original survey date.

In addition to differences in appearance, the runoff that attracted attention to the site in the spring is likely to be nonexistent during the summer and fall. If the information on the form is insufficient, the technical team may need to ask volunteers to revisit the problem area.

Be as accurate as possible when filling out the site identification section of the survey form. Accurate and detailed information is critical to locate the site.

9. Document the time spent on the project.

Documentation of volunteers' time may prove valuable in demonstrating the level of commitment that a group of individuals, an organization, or the town has made to the project. This information may be useful if additional assistance is needed for a follow-up project to fix problems that have been

identified in the survey. Therefore, keep track of how much time is spent on the survey. This includes time spent in training, preparation for going out in the field, actual surveying, and organizing the forms and pictures for delivery to the volunteer coordinator.

10. Organize and give survey information to the volunteer coordinator.

After surveying your area, review the documentation. Do this while the information is still fresh in your mind. Make sure the survey sheets are complete and legible. Photographs should be labeled and attached to the corresponding watershed survey. Problem sites should be clearly numbered on the area map. Submit all the materials to the volunteer coordinator.

The steering committee and volunteer coordinator should arrange any follow-up work, such as revisiting the sites identified to determine how severe the problems are and making recommendations to correct them. Once the follow-up is done, a draft report (Section 5) will be prepared and sent to all volunteers. The report will present an overview of the extent of sediment problems, and associated phosphorus problems, in the lake watershed and should summarize the problems observed by category. A meeting also may be helpful before or after drafting the report to share the results with the volunteers and involve them actively in discussions about the results and how to use them in an action plan.

11. Volunteer involvement does not need to end.

In many ways, the report is another beginning, and it presents new opportunities for volunteer involvement. All participants of the survey—field volunteers and steering committee members—should participate in the discussions of a Watershed Action Plan to address the problems identified in the survey. The DEP Regional NPS Coordinators can assist with technical issues. The lake watershed survey results can be used to reach out to non-traditional groups, such as schools, churches, businesses, and community organizations, as well as landowners. This is an ideal time to create stewardship teams of volunteers and landowners. Working together, stewardship teams can seek practical ways to implement the action plan.

Getting Results from the Survey—Steering Committee & Volunteers

Section 5

What's Here?

Prepare a Draft Report
Develop a Lake Watershed Action Plan
Best Management Practices
Preparing the Final Report and Recommendations

Prepare a draft report.

The draft report does not have to be lengthy—it should be clear, complete, and concise. Survey information must be assessed carefully and presented accurately. Convey information on the extent of problems in the lake watershed as clearly as possible. Include information about the number of problems and where they were found. The draft report should summarize the important findings and lay the foundation for the Action Plan that will be built around the results in the report.

Tally the number of sites identified and categorize them by land use. This table is an example:

Land Use:	Number of Sites
Urban	16
Town Roads	21
State Road	2
Residential	18
Residential shoreline	12
Construction	5
Commercial	3
Forestry	1

Briefly discuss the most frequent problems found for each major land use. In preparing the report, consider your target audience and the most appropriate format to reach them. Consider the level of detail needed for the audience and the balance of text, data, graphics, and pictures. Highlight some particularly significant problems with graphs, illustrations, and photographs.

Publicize survey findings on the extent of point and nonpoint source runoff problems in the watershed. This information should be made available to the towns in the watershed as soon as it is available. If a town official (planning board member, selectman, or town manager) is not on the steering committee, one should be contacted to determine where the report should be sent. Copies of the draft report should be given to local libraries. Landowners also should be notified of the report's availability. If possible, a presentation of the information should be given for landowners and others interested in the survey.

The press also may be interested in preliminary findings. Remember to keep communication open during the entire process to maintain good public relations within the watershed community.

Include the field volunteers and be sure to let them know that survey data are being used. To maintain interest in the project, it is necessary for the volunteers to see the draft report in a timely manner and to know that their efforts are showing results. With the draft lake watershed survey report in hand, the steering committee, field volunteers, and others are ready to move into the next phase of the lake tershed survey project.

Action Plan activities can have regulatory requirements. Local, state, and federal agencies should be contacted and involved early in the work plan development process.

ROADS - Example of Observations and Best Management Practices

Site ID#	Type of Problem	Type of Solution (BMP)	Priority	Level Technical Asst. Needed	Cost	Identify Landowner Cooperation
1	Severe, road surface erosion into lake	Divert water away from road to vegetated areas. Use more culverts, if needed	high	high	med	possibly
2	Clogged culvert	Reshape road, add a berm and a box culvert. Maintenance, clean out, or possibly replace culvert	med	low	low	yes
3	Large area of exposed soil in ditch, drains to stream	Reshape, seed, and mulch	high	low	low	yes
4	Moderate shoulder erosion	Determine cause, add new material	low	low	low	yes

Develop a lake watershed management action plan.

Using the survey report as a foundation, the next step is to develop a Lake Watershed Management Action Plan. In the Action Plan, the problem sites from the lake watershed survey will be redefined into a list of realistic objectives and activities that can be accomplished within the watershed. The Action Plan objectives and activities need to be designed to advance the desired outcome or main goals of the survey, including the following:

- Minimize and eliminate existing and future sources of erosion to decrease the amounts of phosphorus and sediment entering the lake.

- Help educate the community of homeowners, businesses, and nonprofit and government agencies about the lake watershed survey and enlist their support for lake watershed management work activities.

To acquire widespread acceptance and support for the Lake Watershed Management Action Plan, the steering committee will need to collaborate with others to ensure that the survey results are integrated with the political, economic, social, and cultural values of the communities in the watershed. The Lake Watershed Management Action Plan should incorporate input from landowners, the steering committee, field volunteers, and all other interested watershed partners so that the objectives and activities reflect a common vision for the future of the lake.

The key steps in developing a Lake Watershed Management Action Plan are 1) to recognize that the objectives of the Action Plan need to be reasonable, 2) to rank and prioritize problem sites documented in the survey, and 3) to make recommendations on lake watershed management activities. This section of the guide outlines some considerations for accomplishing these key steps.

1. Understand lake watershed management constraints

Recognizing that all the problem sites cannot be addressed simultaneously is the first step toward developing a realistic Action Plan for a lake watershed. Other factors to consider are financial, political, institutional, legal and regulatory, social, cultural, and land and water use conflicts. Any of these can affect the feasibility and outcome of a management effort.

To determine the feasibility of correcting problem sites from the survey list, the steering committee should evaluate the challenges and issues affecting management and restoration efforts. This can be done by considering some potentially significant limitations, such as cost, landowner willingness, and availability of technical resources. Survey results will be adequate to identify lake watershed management needs in many situations, and may show that a more thorough assessment of the lake and the problem is advisable and necessary.

The matrix of road-related problems is a tool that can be used to determine which problems in a lake watershed can most readily be addressed, all factors considered. A matrix should be developed for each land use. When developing the matrix, ask questions such as: What sites can be corrected easily without spending significant resources? What are the most significant sources of pollution? Does this activity have support or opposition?

2. Rank and prioritize sites

The next step is to rank the problems based on their seriousness and make recommendations for corrective actions. A priority ranking of the sites can be done on a simple, low-medium-high scale, and the following criteria should be considered in site rating and ranking:

➢**Site conditions assessment score**—An average score for the site can be computed and interpreted as low, medium, or high for the purposes of ranking and prioritizing sites.

➢**Size of the area affected by the problem**—How large is the problem area? Is it a few square feet, half an acre, 10 acres? This factor is especially important where soil erosion is the problem. Generally, the larger the area, the more significant the problem.

➢**Slope**— Steeper slopes cause greater soil erosion. Runoff tends to concentrate in channels more quickly, and does not filter through the soil where it would be treated.

➢**Type of soil**— Generally, soil type is important in ranking a site for phosphorus loading. Loam contains more phosphorus than sand, and clay contains more phosphorus than loam.

➢ **Distance between the problem site and a ditch, stream, or the lake itself**—Generally, sites closer to the lake should receive higher priority ranking than those farther away, when the problems are equivalent or similar.

➢**Land use considerations**—Changes in land use patterns and increased development increase stormwater runoff, which affects sediment and nutrient transport. Trends toward increased watershed development will make the lake watershed more vulnerable to further impairment.

➢**Site capacity for management (e.g., adding a vegetated buffer)**— As a practical matter, sites that have a greater potential to be managed or restored should be rated higher. For example, there may be community consensus that the recreational value of a swimming beach is more important. Accordingly, it would be easier to plan management activities in response to a beach-related problem.

(NOTE: The scale of the problem will affect the scale of the Action Plan activities required. Therefore, a high rating for size, may be offset by a low rating for site management capacity. Priority rating systems need to be interpreted with caution. There is a danger that the public or whoever is reviewing the list of sites will be drawn only to sites with a relatively high rating. However, the ***cumulative impact*** to water quality of many low priority sites can outweigh a few high priority sites. Low priority sites also may be easier to correct than large-scale problems.)

3. Recommend realistic objectives for the Lake Watershed Management Action Plan

The Action Plan objectives may be considered secondary goals in that they directly or indirectly support the main goals for the survey and lake watershed management project. Realistic Action Plan objectives reflect community needs and significant lake watershed issues. They give direction for development and implementation of management activities. Realistic objectives also are measurable, in order to provide a basis for monitoring project success. The following are examples of measurable objectives:

- Decrease erosion,
- Reduce sediment entering a lake, and
- Install BMPs to reduce sediment.

4. Recommend realistic activities for the Lake Watershed Management Action Plan

Once objectives are established, a list of corresponding activities can be developed. Action Plan activities are based on a site's potential for management, which is not necessarily a plan for restoration to an unaltered or entirely natural state. This ideal situation may not be achievable, given the constraints that have been identified.

In this step, general solutions or overall strategies are being recommended to address the objectives. The steering committee and technical team should be familiar with technically feasible alternatives. Some of the concepts for management and restoration are outlined briefly, later in this section.

Realistic activities also should be measurable, in order to provide a basis for monitoring project success. For example, management activities could propose planting 20% of unvegetated lakeshore each year for five years, and that native vegetation planted along the lakeshore would show a 50% survival rate after 3 years. A landowner's agreement for survey-related work also would be a measurable success.

Best Management Practices (BMPs)

Making recommendations for Action Plan objectives and activities requires an understanding of the options available to improve water quality of the lake. Options range from simple solutions, such as lake cleanup days, to constructed BMPs. Knowing what BMPs are available and appropriate for typical lake watershed problems is basic to recommending management work.

BMPs are specific practices that have been designed to protect water quality from the effects of development. Mitigation with BMPs is less costly when it's incorporated into long-range land use planning. Adding BMPs after a problem exists may be difficult, or even impossible, due to site limitations. But just as every problem site in a watershed contributes to the cumulative damage to lake water quality, even a limited amount of mitigation can lead to improvements in water quality. Therefore, BMPs should be considered for developed sites, despite site limitations.

Information on BMPs is readily available through all search engines on the Internet. Some suggested Web site references are listed in Appendix D. BMPs to protect lakes from phosphorus and sediment in stormwater runoff should have one or more of the following capabilities:

- **Reduce soil erosion by stabilizing exposed soils.** Soil erosion is a major source of phosphorus and sediment to lakes. Many erosion problems can be eliminated easily by seeding and ***mulching*** exposed areas. Some problems have complex causes and may require evaluation by professionals. By reducing the number of erosion problems in a lake watershed, phosphorus and ***sediment loading*** to the lake can be reduced significantly.

- **Minimize vegetation loss, or replace vegetation that has been removed.** As the natural forest cover is removed, stormwater runoff increases. In addition, the natural sediment and phosphorus filtering (buffering) capability of the vegetation is lost. By minimizing vegetation loss, erosion problems also are minimized.

Generally, native trees, shrubs, and ground cover vegetation are preferable to lawns. Replacement vegetation should mimic natural forest conditions in the area, if possible. However, many property owners may prefer the appearance of a landscaped buffer, which can be effective, when designed properly. Vegetated buffers, greater than 100 feet wide, along streambanks greatly reduce nutrients and sediments; cool water; and provide critical habitat.

➢**Reduce stormwater runoff volumes and velocities by minimizing the amount of impervious area.** Road and driveway lengths should be minimized, where possible. Parking lots and building areas also should be minimized. Runoff from small paved areas should be diverted directly to the shoulder and into vegetation. Avoid use of curbs and gutters, which collect water, where possible. By reducing impervious area, less runoff is generated during storm events. This means less phosphorus, sediment, and other pollutants in the runoff. It also means the runoff is less likely to find its way to a stream or the lake.

➢**Divert runoff from developed or disturbed areas to vegetated buffers or areas where runoff can filter into the ground.** This practice reduces the amount of phosphorus and sediment in stormwater runoff. Runoff from buildings, parking lots, driveways, roads, construction areas, farmlands, and logging areas should not discharge directly into streams or the lake without first receiving some level of treatment to reduce pollutants. Natural woodland buffers are very effective at reducing phosphorus and sediment from stormwater runoff. Grassed areas, while less effective than woodland areas, can provide some treatment. For buffers to work, they must be located between disturbed areas and the lake, or any ***channel*** (road ditches, ***swales,*** and streams) that could carry runoff to the lake. The effectiveness of a vegetated buffer depends on the width of the buffer, the slope of the land, soil type, and the types and densities of vegetation growing in the buffer.

➢**Control phosphorus by limiting opportunities for transport with sediment and stormwater runoff.** It has recently been found that residential lawns contribute significantly to the total load of many pollutants, especially phosphorus. Reduced fertilization, application of only the amount recommended, and use of organic or slow-release fertilizers will limit nutrient release. Lakeshore areas and tender young grasses also are attractive to Canada geese, with feces that are another source of nutrients. Maintaining and planting dense natural stands of trees with shrubby undergrowth and tall, unmowed grasses will provide natural obstructions to goose movement through the area.

➢**Redirect surface runoff that is sediment free and clean away from areas prone to erosion.** This practice may be adaptable to many of the land uses. It will reduce sediment loads to waterbodies. For example, in a residential area, rooftop runoff could be discharged to a dry well where it will be absorbed by the ground, instead of being discharged to a sloping lawn which directs runoff into a brook.

Planted Buffers

Vegetated buffers help keep water clean. Buffers may be either natural or planted vegetation between a developed area and a waterbody.

- Use native plants because they do not require fertilizer after establishment.
- Natural buffers hold sediment, and capture polluted runoff and excess nutrients.
- Forested areas are most effective; they also regulate water temperatures and enhance habitat.
- Over time, landscaped buffers can be as effective as natural ones. Effectiveness increases with increasing width.

Non-structural and structural BMPs

For both non-structural and structural BMPs, the design should control the pattern of sediment transport. Non-structural best management practices are activities that landowners can undertake to control sediment and phosphorus before they are released into the environment, where pollutants can be transported to the lake. Examples on non-structural BMPs are reduced fertilizer use, changes in application of fertilizers, street sweeping, and regular inspection of septic systems.

Engineering and design issues relating to BMPs are beyond the scope of this guidance. Numerous publications are available on BMPs for a variety of land uses.

When non-structural measures are insufficient or infeasible, it may be possible to use structural BMPs for a point or non-point pollution problem in the lake. Structural measures include vegetative stabilization of shoreline and streambank areas, grassed swales or ditches with checkdams to slow the velocity of runoff, lakeshore buffers and management areas, and stormwater BMPs for control of sediments. The bibliography (Appendix G) provides references to Massachusetts publications for structural BMPs.

Land use and BMPs

Construction sites

Erosion rates from construction sites are much greater than other land uses. Even though most new construction sites are required by federal, state, or local regulations to have erosion and sedimentation plans, field surveys may reveal the use of inadequate or poor best management practices on construction sites. Unmanaged construction sites can contribute 7 to 1000 tons of sediment per acre during a year to a lake. Generally, erosion control methods should effectively hold soil in place so that it cannot be washed away by stormwater runoff.

Construction site BMP checklist

- ☐ Use nonvegetative soil stabilization.
- ☐ Use barriers such as silt fences and hay bales.
- ☐ Seeding and mulching exposed soil.
- ☐ Limit disturbed area.
- ☐ Project phasing to minimize bare soil.
- ☐ Use sedimentation basins and clean out sediment frequently.
- ☐ Stabilize construction roads.
- ☐ Cover and immobilize stockpiled soil.
- ☐ Remove excess soil as soon as possible.
- ☐ Use measures (e.g., checkdams and swales) to dissipate flow and velocity.

Residential areas

There is a direct link between water quality and chemicals used to maintain lawns and gardens. Although more research is needed, the types, quantity, and timing of chemical applications make a significant difference. Landowners need to be educated about the use of fertilizers and the impact of lawns on lake water quality.

In residential areas, look for low maintenance, long-term BMPs that can be implemented readily and inexpensively by homeowners. Use of aesthetically pleasing landscape materials to divert runoff from eroding slopes, planting vegetation, adding berms to driveways or use of porous pavers in driveways, and minor regrading are examples of achievable activities. Homeowners also should be educated about the use of fertilizers and the impact of lawns on lake water quality.

Residential BMP checklist

- ☐ Plant vegetation for soil stabilization.
- ☐ Add vegetated buffers along lakeshore.
- ☐ Limit and stabilize the number of lakeshore access points.
- ☐ Use porous pavement for driveways.
- ☐ Divert stormwater runoff (e.g. to grassed swale).
- ☐ Dry wells to capture and infiltrate rooftop runoff.
- ☐ Minimize and control use of fertilizers and pesticides/herbicides on gardens, lawns, and landscape plants.
- ☐ Minimize lawn areas–plant perennials–particularly along lakeshore (for geese control).
- ☐ Use non-phosphorus fertilizers on lawns.

Roads

In many areas, road systems will be the greatest source of imperious cover. When stormwater comes in contact with roads, accumulated sediment, oil and gas residue, and pollutants are washed off at higher velocities. Sediment and road salt accumulation are higher in early spring, after a winter season of storm de-icing. Look for solutions that address poor design, location of roads, and inadequate drainage systems, as well as road maintenance options to correct erosion and sedimentation problems.

Road BMP checklist

- ☐ Reshape road or add berms to redirect stormwater runoff away from lake or stream.
- ☐ Use pavement materials that are not susceptible to erosion.
- ☐ Reposition culvert inverts.
- ☐ Stabilize culvert inlets and outlets.
- ☐ Vegetate slopes and road ditches.
- ☐ Add ditch turnouts.
- ☐ Street sweeping.
- ☐ Clean out catch basins.

Agricultural areas

Because of extensive areas of exposed soil, agricultural land uses can be significant sources of phosphorus, sediment, and other pollutants. Well managed farms that use conservation practices can reduce water quality impacts to lakes and other waterbodies. Many resources that address agricultural BMPs are available.

Agricultural BMP checklist

- ☐ Plant vegetative buffers along lakes, streams, and wetlands.
- ☐ Use winter cover crop, rotation.
- ☐ Leave vegetation along ditches to capture field runoff.
- ☐ Fence animals out of streams and waterbodies.
- ☐ Create adequate stream crossings.
- ☐ Spread manure on unfrozen, dry ground.
- ☐ Properly design and maintain manure storage areas.
- ☐ Fertilizer management, based on soil testing.
- ☐ Integrated Pest Management

Urban

Urban environments are heavily impacted by development. Paved and impervious cover accumulates pollutants, reduces infiltration of rainwater into the groundwater, and accelerates the rate of runoff. Rivers rarely resemble a natural state. Most are culverted, dammed, straightened, or flow underground. Urban land use is a significant contributor to water quality problems. Waste from domestic animals and birds, such as pigeons, geese, and gulls also can be a problem for urban lakes and ponds. Consequently, urban areas pose significant problems that will require nonstructural and structural best management practices, long range watershed planning, and possibly local ordinances and bylaws to manage phosphorus, sediment, and pollutant loadings. BMPs need to address high levels of metals, nutrients, and contaminants from urban areas.

Urban BMP checklist

- ☐ Reduce impervious surfaces.
- ☐ Use porous pavement for parking lots.
- ☐ Direct roof top runoff to groundwater.
- ☐ Provide flood storage.
- ☐ Routine street sweeping.
- ☐ Nonstructural practices (e.g., spill prevention and containment, material storage, and housekeeping) to limit the release of pollutants.
- ☐ Use and maintain stormwater controls (BMPs).
- ☐ Check BMPs for damage and build up.
- ☐ Monitoring BMPs periodically to ensure that the schedule for maintenance is adequate.

Forestry (logging)

Harvesting forest products requires the use of heavy equipment, which disturbs soil and causes the release of sediments. Phosphorus and sediment concentrations in runoff from actively forested areas can be very high. Forestry is heavily regulated in Massachusetts; forest cutting practices regulations required the use of BMPs to prevent or minimize water pollution impacts. These regulations are supported by other state and federal regulations and funding programs. Use the *Massachusetts Forestry Best Management Practices Manual* to address forestry -related problems. Required BMPs are highlighted and differentiated from recommended practices and activities in that guide.

Forestry BMP checklist

- ☐ Regrade, smooth, and repair ruts and shoreline or streambank landings.
- ☐ Vegetate or stabilize and smooth roads and skid trails that are no longer used.
- ☐ Limit skid trails and locate where stream bed is firm and avoid steep or undercut banks.
- ☐ Maintain stream and shoreline buffers and filter strips.
- ☐ Clear culverts and stabilize inlets and outlets.
- ☐ Use barriers such as hay bales and silt fences.
- ☐ Maintain ditches, waterbars, and culverts.
- ☐ Use barriers such as hay bales and silt fences.
- ☐ Avoid stream crossings wherever possible.
- ☐ Use Integrated Pest Management (IPM) and best management practices for pesticide and herbicide use.

Prepare the final report and recommendations.

The final report is more comprehensive than the draft report. Input from all participants in the survey should be solicited in preparing the report. Shared ideas from the steering committee members, technical team, and volunteer surveyors will help to create a thorough and balanced report.

The final report may be used and referenced for many years in the future. If the lake should experience a change in water quality, the report may be valuable for providing historical perspective on the types of problems that have existed in the watershed. The documentation of watershed protection efforts by the community may also help to get funding for mitigating future problems.

The final report should include the following:

- ➢ A discussion of types of problems identified for each land use.
- ➢ General recommendations for fixing each site.
- ➢ For sites where technical assistance would be required in designing and implementing BMPs, (conservation measures) the appropriate resource agencies should be identified.
- ➢ Identification of potential sources of funding to fix problems.
- ➢ A description of the overall level of development in the watershed relative to the number, type, and severity of problems.
- ➢ Information that provides precise information about the location of sites, but does not make specific reference to the name of the landowner.
- ➢ To avoid alienating landowners, do not include landowners' names in reports that are available to the public.
- ➢ A map(s) depicting the lake watershed, survey area, and the general location of the sites.
- ➢ A priority ranking of the sites based on their level of severity.
- ➢ While fixing the problems documented in the survey is generally beyond the scope of the project, ranking the problems based on their seriousness and making recommendations for corrective efforts is not.

If certain types of problems are recurrent throughout the watershed, recommendations could be made for developing local ordinance standards to prevent similar problems from occurring in the future. For example, if the road ditches in residential subdivisions are consistently found to be unstable and eroding into streams, a standard could be added to the local subdivision ordinance. Such a standard might require developers to stabilize ditches with vegetation or stone and to direct runoff from ditches to well-vegetated wooded areas, so that phosphorus and sediment would be filtered out.

If development has taken place on land with severe limitations such as very steep slopes, highly erodable soils, high water table, or any other factor that would increase the likelihood of soil erosion, this information should be included in the report. Town comprehensive planning committees and conservation commissions may find this information helpful in establishing long-term lake protection programs.

Survey information can help to identify areas of the watershed where existing land uses have resulted in significant NPS problems due to poor soils, steep slopes, or other natural limiting factors to development. This information also may highlight the need for comprehensive lake water quality protection and serve as a basis for recommending that a town adopt a phosphorus control policy that can be used when reviewing new land use applications.

Appendices

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Tips for Surveying a Lake and Pond Watershed SAMPLE

The purposes of this survey are to organize residents and officials of communities to work together to solve problems and to protect resources of lakes and ponds. The survey, a cooperative venture, is a primary step in this process. In addition, the success of the survey depends upon volunteers and landowners. Before the survey takes place, all landowners need to be invited to participate in the survey, notified of purposes of the survey, and have an opportunity to give permission for volunteers to walk their property.

This survey form is designed for use with the *Massachusetts Volunteers Guide for Surveying a Lake Watershed and Preparing an Action Plan* (2001). To ensure that the survey is successful, volunteers should be aware of the following safety tips.

Safety and Legalities

- Always walk with someone.
- Watch out for irate dogs. Walk cautiously and practice good dog etiquette.
- Do not drink the water.
- Lifejackets are required by law for each person in any canoe or boat.
- From September 15 to May 15 all canoe or kayak occupants must wear a U.S. Coast Guard Approved Personal Flotation Device.
- Wear long-sleeved shirts and pants to protect against, ticks, mosquitoes, poison ivy, and nettles.
- Wear insect repellent if necessary.
- Consider landowner rights. Ask permission to cross private land, posted or not.
- Do not enter posted areas without permission. Take advantage of public access points.

Environment:

- Don't walk on unstable banks; your footsteps could speed erosion.
- Be aware of wildlife and animal homes, for both of your sakes.

NEVER PUT YOURSELF IN DANGER TO GATHER SURVEY INFORMATION.

If at anytime you feel uncomfortable about the bank or waterbody conditions or surroundings, please STOP your survey. You and your safety are much more valuable than any of the objectives of the watershed survey.

Checklist: What to take on your survey

___ A buddy
___ Data forms and topo map
___ Clipboard or other surface for writing
___ Two pencils – color is good to mark on maps
___ Long-sleeved, snag-free clothing /pants (for bugs and thorns)
___ Sunblock
___ Sunglasses (polarized to see into the water better)
___ Lifejackets & paddles if canoeing
___ Camera and film
___ Gloves
___ Copy of letter sent out to landowners
___Flashlight for checking culverts

Fill out your data sheets, get them to your team leader, and attend action planning meeting, which will be held on: _____

LAKE and POND **WATERSHED PRESURVEY** FORM

Lake and Watershed Name: _____
Survey Area Number: _____
Surveyors Names: _____

A. Description of the Area from a Topographic Map *(Maps will be available at the training session.)*

1. Do you see developed *(white)* and undeveloped areas *(green)*? What % of each do you see?
   _____% developed _____ % undeveloped

2. Are the banks of either the tributary or shoreline steep, (*How close together are the contour lines*?)
   indicating a potential for increased runoff or erosion?
   ____Yes ____No

3. How many tributaries enter or cross your area?

4. What kinds of development are shown on the map? *(Include major development in the watershed, as well as the shoreline, that could have an impact on the lake.)*

B. General Categories of Land Uses in your Area
___ % Construction
___ % Residential
___ % Roads
___ % Agricultural land
___ % Urban
___ % Logging/forestry
___ % Other (*please specify, e.g. , rural, open, or recreational)*_____

C. If Residential *(Estimate % of area;information will be available at the training.)*
___Multifamily ____year round
___<1/4 acre lots ____seasonal
___1/2-1 acre lots
___>1 acre

D. Is the area sewered? _____ or unsewered _____?

E. Watershed History and Characteristics *What do people know about this area?*
General description:
_____

_____

Historical Information:
_____

_____

_____

LAKE and POND **WATERSHED SURVEY** FORM

Lake and Watershed: _____ Survey Date: _____

Surveyors Names: _____
Area Number: _____
Site Location: Beginning _____ End: _____
Weather Today: _____ Weather (past 2-5 days) _____
Landowners Contacted During Survey: ____yes ____no
Description: Is the lake or pond a… *(Please check)*
___Naturally occurring lake or pond ___Lake or pond created by a dam ___Salt pond

A. General Categories of land uses on the Problem Site *(Identify the land use category on the problem site. May be more than one land use.)*

___ % Construction
___ % Residential
___ % Roads
___ % Other *(please specify, e.g. , rural, open, or recreational)* _____
___ % Agricultural land
___ % Urban
___ % Logging/forestry

A.1. Specific Land Use on the Problem Site *(Estimate % of site in each use. May be more than one land use.)*

___commercial
___industrial
___junk yard
___railroad
___bridge
___highway
___dirt road
___local road
___parking lot
___golf course
___grazing/pasture
___park or beach
___protected open space
___undeveloped land
___meadow
___forest
___wetland
___other *(specify)* _____

A.2. If Residential *(Estimate % of site that is…)*

___Multifamily
___<1/4 acre lots
___1/2-1 acre lots
___>1 acre *(400 x 100 feet)*
___year round
___seasonal

B. Site characteristics

1. Dominant soil is…
___rock ___gravel ___sand ____silt ____clay
2. Slope of site is…
__flat ___moderate ___steep

3. The bank is… *(Check a or b, if there is a stream, ditch, shoreline, or steep bank on site.)*

_vegetated with…
___exposed roots
___shrubs and native grasses (< 20 feet)
___trees taller than 20 feet

b)___unstable and…
____undercut
____eroded

LAKE and POND **WATERSHED SURVEY** FORM
(Continued, page 2)

C. Site drainage

1. Site runoff is directly to…

__lake ___stream ___ditch ___ catch basin ___vegetated buffer ___wetland other *(describe)*_____

2. Site runoff is from…

Construction: ___ disturbed areas <1 acre) ____disturbed areas >1 acre
Residential: ___ <1 acre ___ >1 acre **and** ___ driveways ___lawns
Roads: ___ pavement to catch basin ___bridge ___shoulders/country drainage
Agricultural: ___ field ____animal grazing area ____manure storage area
Urban: ___ parking lot ___vehicle maintenance yard ____industrial area ___waste storage area
Logging/Forestry: ___ logging yard ___roads/trails ___stream crossings ____forested areas

D. Land disturbances that affect water quality

1. Do you see evidence of excess nutrients? *(Check all that apply)*

____**Soil erosion:** ____silt _____sand ____soil ____stockpiled soil ____sedimentation
____**Evidence of runoff:** ____gullies ____rills ____channel
____**Evidence of nutrients:** ___pet waste/manure ____fertilizer use ___green lawns other*(specify)* _____

2. Do you see any of the following? *(Use the same land use categories that were selected for the site.)*

Construction: ____exposed soil ___altered drainage pathways ____absence/failure of erosion controls
Residential: ____exposed soil ___ lush lawns ____evidence of erosion ____ pet waste ___ pipe drains
Roads: ____drainage to waterbody ___evidence of erosion ___sediment in ditches/culverts/drains
____ sand build up in road
Agricultural: ____exposed soil ___ animals in waterbody ___ storage areas uncovered
Urban: ____drain pipes to waterbody ___sediment in ditches/culverts
____ paved areas near waterbodies ____ trash/waste storage near waterbodies
Logging/forestry: ____ exposed soil ____ poor roads ____brush/slash near waterbodies
Other: ____ *(specify)*

_____

3. Do you see any of the following? *If there are tributaries, catchbasins, drain pipes, and/or culverts on the site,*

explain your observations.

____Tributaries bringing in siltation:_____
____Condition of the culvert/pipe:_____
____Describe what is going into the pipe *(add color and odor)*:_____
____Describe any discharge from the pipe *(add color and odor)*:_____
____*Try to obtain and attach a map of the drainage system through your site/area.*

Lake Watershed Survey
Area Summary Sheet 1: Narrative

Area begins: _____

Area ends: _____

Date:_____
Surveyors:_____
Today's weather:_____
Weather over past 24-48 hours:_____

SAMPLE

These sheets are designed to (1) give the "big picture" of your area, and (2) describe the problems you have seen that could contribute to impaired water quality in the waterbodies of your watershed. The problems you have seen should be marked on your map (A, B, C, D) and described here. Identify the source of the problem whenever possible. This information provides the basis of the narrative description in your Lake or Pond Watershed Survey Report.

NARRATIVE DESCRIPTION

Sample.
We surveyed the south side of the pond from Oak to John Street. **(A)** There is a small stream, (about 1.5 feet across and 0.5 inched deep) that comes in just east of 3 Oak Street. The stream has a deep tea color but does not smell or have any algae. The bottom of the lake in this area is covered with decaying leaves/muck. This area also has woods coming up to the pond edge- a really well established vegetated buffer and lots of song birds. **(B)** From 3 to 17 Oak Street, people's lawns come up to the edge of the water-no buffer. Some dumping of yard wastes close to the shoreline.

(C) Lots of illegal dumping- at the end of the maintenance access road for Rte. 13 (mostly construction type stuff)! There are 3 large erosion gullies beneath the pipes sticking out of the embankment (from the storm drains on the highway), and there is a large delta of sand forming in the water beneath the embankment. Smells like gasoline and there was a sheen in the water trapped by the tires. This area could be cleaned up and it would make a great boat ramp area. Plant a few trees and it would be a nice place to sit-the view is nice. Can we get permission from Mass Highway to do clean up work near Rte. 13?

(D) There is a thick coating of duckweed along the edge of "Ball Park Cove" and the rest of the cove is thick with milfoil, (a neighbor says it is milfoil-we are not sure). The storm drain across from a new subdivision, (intersection of Oak and John Streets), is clogged with dirt from the construction site.

Describe your area in a paragraph:

Lake Watershed Survey **Area begins:**

Area Summary Sheet 2: Priorities for Action **Area ends:**

SAMPLE

Look back at your data sheets and include your observations. The information from this sheet will be used to develop the Watershed Survey Report and Action Plan.

PROBLEMS: Problems found in your area, such as pipes or culverts discharging in dry weather, erosion, runoff, trash, dense algae, water quality problems (odor, color, oil, foam, sewage), and degraded wetlands (phragmites, loosestrife) *(Describe and give location).* 1. 2.	ASSETS: Assets found in your area, such as good habitat, wildlife species, businesses, or landowners using the river (in a friendly way), recreational access (canoe, trails, parks), potential recreational access, and potential park/conservation land *(Describe and give location).* 1. 2.	PRIORITIES FOR ACTION: List items that you feel would help to address or correct the priority problems in column 1. 1. 2.

MAPPING PAGE

Survey area:_____ Begin:_____ End:_____
Surveyors:_____
Date:_____ Weather today:_____ Weather past 48 hours:_____

Draw a birds-eye view of your problem site, showing vegetation types and canopy along the streambank or shoreline, land uses, and other features. Include such as pipes, drainage ditches, or connections to wetlands or tributaries. Add assets such as habitat, recreation, and open space. If there is enough room w description next to the problems found on site. If you need more room, label the problems A,B, C, on the map and describe these problems on the Narrative Sheet. Be sure to include the following information : (1) where you have taken photos --use arrow showing direction, include photo number, (2) Mark prol and photo numbers on topographic map of your area. *(See sample on reverse side.)*

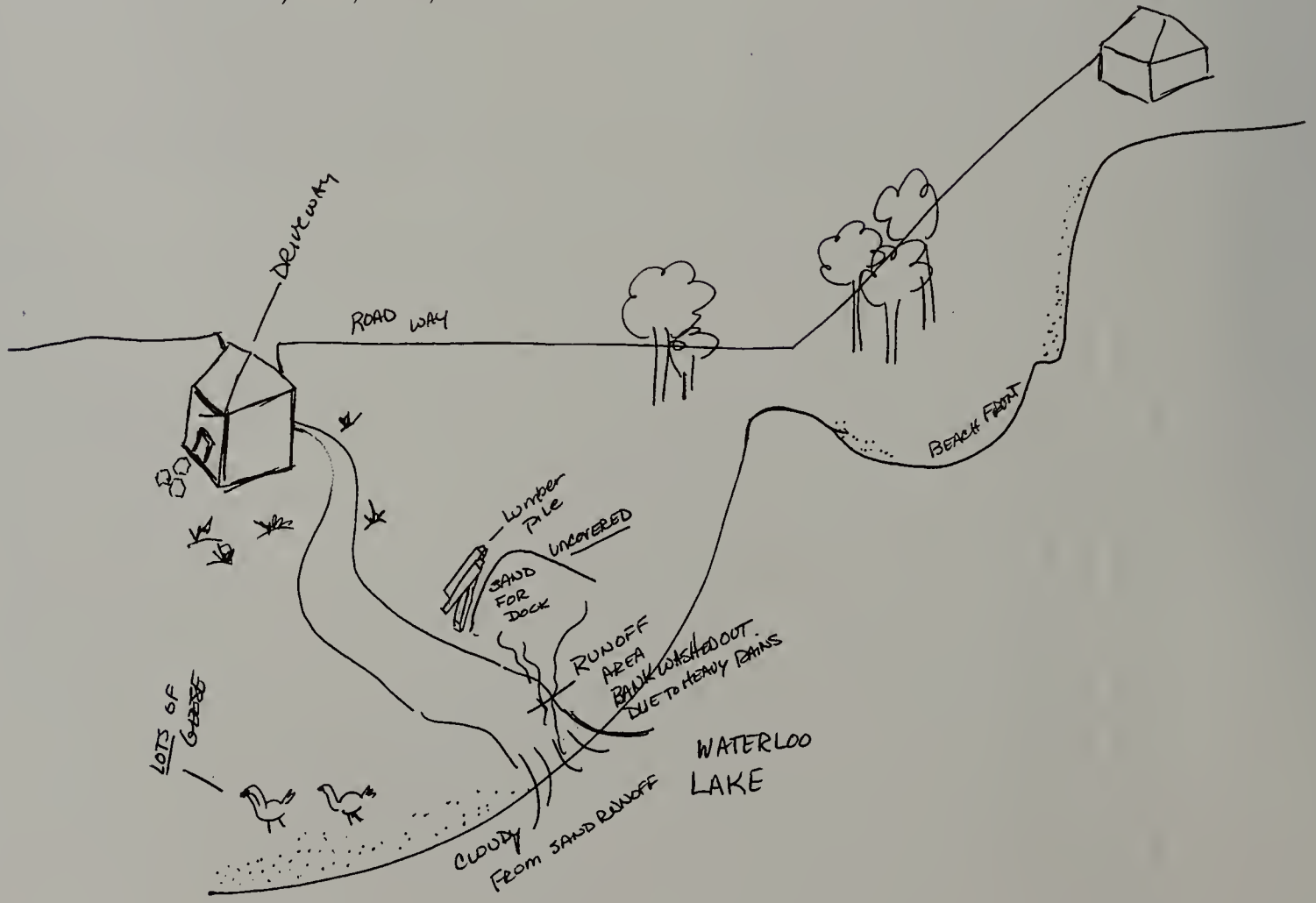
SAMPLE

SAMPLE ATTACHMENT

Geese near shoreline, photo #27

Algae growth near shoreline, photo #23

Drawing #1 for Waterloo Lake Survey
Parcel #33, 11/12/00



COMING ATTRACTION!

SAMPLE

Lake Watershed Survey Coming to Your Neighborhood!

Dear Lake Property Owner:

Many Massachusetts lakes have shown evidence of water quality decline in the past few decades. Lake watershed property owners can be affected when lake water quality declines. In addition to undesirable aesthetic changes to lake water, the potential impact to aquatic life, and the negative effects on your use of the lake, property values could be lowered.

As you may know, lakes, streams, and other waterbodies are interconnected within a watershed. A watershed is the area of land which drains to the lake through ditches, wetlands, streams, or rivers. By surveying a lake watershed, it is possible to find the causes and sources of pollution to a lake. Lake watershed surveys, like this one, are being done in watersheds across the state by trained volunteers.

The Waterloo Lake Association is conducting a survey of the Waterloo Lake watershed mainly to locate sources of phosphorus and sediment which may be having a negative effect on lake water quality. Erosion is the focus of this survey because it is a major source of phosphorus — a serious pollutant to lakes. Phosphorus and other pollutants reach our lakes through stormwater runoff and can come from anywhere in the watershed — not just the shoreline. The goals of this survey are to locate pollution sources, make recommendations to reduce or eliminate them, work with landowners to find reasonable solutions, and ultimately to protect the water quality of the lake for future generations. During the course of the survey, volunteers will be requesting access to property within the watershed. These volunteers also may be able to answer your questions about the effects of pollution in your water. There will be ways for you to participate. We need your help in eliminating the causes of the pollutants, and you are invited as a lake watershed property owner, to become part of this effort to restore our lake's well-being. Please call the number below for workshop and training information, if you have questions about the survey, or ideas that may be helpful in conducting the survey.

Contact Person: Scarlett O'Hara or RhettButler

Telephone: 508-555-5555

Best time contact person can be reached: Mon. - Fri. 7:00-8:30 pm, anytime Saturday and Sunday (leave message)

Massachusetts WaterWatch Survey Forms

EXAMPLE

INTENSIVE SURVEY FORM

Stream name: _____ **Segment code:** _____

Segment Start: _____ **Surveyor(s) :** _____

Segment End : _____ **Date:** _____

When filling out this form, record *average* values for the entire survey segment:
If you observe any high-potential resource areas, pollution sources, or other phenomena, which might bear a closer look, please record them on your map and in the narrative section of the form.

ADJACENT LAND

General land use. What is the nature of the land use within 1/4 mile of either bank?
Use approximate percentages for each use encountered. List each side of stream.
Ranges: 0 - 10%, 10 - 25%, 25 - 50%, 50 - 75%, 75 - 90%, 90 - 100%

Forest (> 20' high)	_____ Left	_____ Right
Shrub (0-20' high)	_____ Left	_____ Right
Pasture _____ Left _____ Right		
Open land (abandoned farm, etc)	_____ Left	_____ Right
Crop (cultivated)	_____ Left	_____ Right
Open perennial (orchards, nursery)	_____ Left	_____ Right
Wetland	_____ Left	_____ Right
Residential :		
R0 - Multi-family	_____ Left	_____ Right
R1 - < 1/4 acre lots	_____ Left	_____ Right
R2 - 1/4 - ½ acre	_____ Left	_____ Right
R3 - ½ - 1 acre	_____ Left	_____ Right
R4 - Greater than 1 acre	_____ Left	_____ Right
Commercial	_____ Left	_____ Right
Industrial	_____ Left	_____ Right
Transportation (RRoad, airports, etc)	_____ Left	_____ Right
Waste disposal (landfills, sewage lagoons, etc)	_____ Left	_____ Right

Width of riparian zone (Is there a band of trees, shrubs, or grasses covering or extending outward from the streambank itself? If so, indicate the average width of this strip.)

Left Bank: ____ 0 - 5' ____ 5 - 20' ____ 50 - 100' ____ 100'+

Right Bank: ____ 0 - 5' ____ 5 - 20' ____ 50 - 100' ____ 100'+

Streamside vegetation. (What % of segment length is covered by the types indicated?)

Left Bank:
None or little ____% Grasses ____% Shrubs (< 20') ___% Trees greater than 20' ____%

Right Bank:
None or little ____% Grasses ____% Shrubs (< 20') ___% Trees greater than 20' ____%

Stream cover. (estimate shading between 10 A.M. and 2 P.M.)

___ 0 - 25% ___ 25-50% ___ 50- 75% ___ 75-100%

Segment code: _____

EXAMPLE

STREAM BANK AREA

Artificial Bank protection. (What % of segment length is covered by the types indicated?)

What is the nature of the artificial surface?
Left: ____ Rip-rap _____ Concrete/other paved surface _____ Wood
____ Junk _____ Other
Right: ____ Rip-rap _____ Concrete/other paved surface _____ Wood
____ Junk _____ Other

Eroded or disturbed banks. (What % of segment length is affected?)
Left bank:
___ 0 - 10% ____ 10 - 50% ____ 50 - 75% ____ 75-100 %

Severity: _____ Low _____ Moderate _____ Severe

Cause: _____

Right Bank:
___ 0 - 10% ____ 10 - 50% ____ 50 - 75% ____ 75-100 %

Severity: _____ Low _____ Moderate _____ Severe

Cause: _____

Any steep banks present in segment?
_____ No _____ Left bank _____ Right bank

INSTREAM CONDITIONS

Flow. _____ Low _____ Moderate _____ High.

Average stream width. (Over length of segment.) _____ Feet

Water color.
____Clear ____Green ____Tea ____Milky____Cloudy _____Muddy

If milky, cloudy, or muddy, rate:

_____ Light _____ Moderate _____ Severe

Water smell.
_____ None _____ Sewage ____ Oil _____ Chlorine _____ Rotten eggs

Presence of logs or woody debris in stream.

____ None _____ Occasional _____ Common

Aquatic vegetation.
1. Do rocks on the stream bottom feel slippery or slimy: ___ Yes ___ No
2. If the following plant types are present, indicate the relative extent within the segment:
   H - high M - Moderate L - low

a. _____ Submergent - plants completely underwater
b. _____ Floating - plants w/leaves floating on the surface
b. _____ Emergent - plants w/leaves rising above water surface
d. _____ Mosses - dense, cushion like mats on rocks
e. _____ Algae - green cotton ball or threadlike films, formless if brought out of the water.

Segment code: _____

RIVER RECREATION

EXAMPLE

1) Accessibility:

	Left Bank	Right bank
By public trail	_____	_____
by private trail	_____	_____
nearby road	_____	_____
nearby parking	_____	_____
with a canoe	_____	_____
not accessible	_____	_____

Reason: _____

2) Would you come back here to:

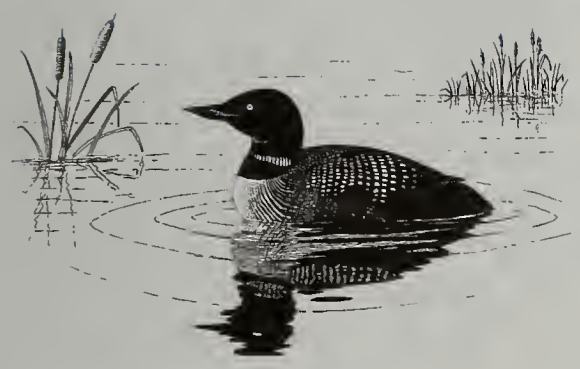
swim _____
wade _____
canoe _____
tube/kayak _____
picnic _____
fish _____
camp _____
bird watch _____
other _____ list: _____

Segment code: _____

SITE - SPECIFIC INFORMATION
Please record here any obvious or potential pollution or problem sources that you find (i.e. pipes (flowing or dry), animal waste entering stream, etc), or any significant resources that you observe (i.e. waterfalls, wildlife, good swimming holes or popular fishing spots, good boating stretches, etc). Describe the occurrence and the location as clearly as you can.

Segment code:_____

The Field Volunteer's Most Frequently Asked Questions



The answers to these frequently asked questions will give volunteers an idea of what to expect.

What are the objectives of this work?

The first objective is to locate as many erosion problems in the watershed as possible. A second, but equally important objective, is to help the watershed community understand how land use in the watershed influences lake water quality. Once awareness is raised, people are more likely to change habits that are harmful to the lake.

How much time is required?

Volunteers attend three to four hours of classroom training. Times in the field will vary, depending on the size of the assigned area. Expect to spend a minimum of two days over the course of a month on this project.

When does the survey take place?

Anytime! For example: If a survey is conducted in the spring, between March and April, these favorable conditions exist:

- The ground is likely to be ***saturated*** with water due to spring snowmelt. Under these conditions, ***runoff*** from rainstorms will be at a maximum. Phosphorus and sediment in runoff from spring storms often represent a large percentage of the total annual phosphorus load to a lake.
- Eroded areas will be more visible due to the absence of vegetation.
- Enough time will remain for the follow-up team to complete the project during the summer months.

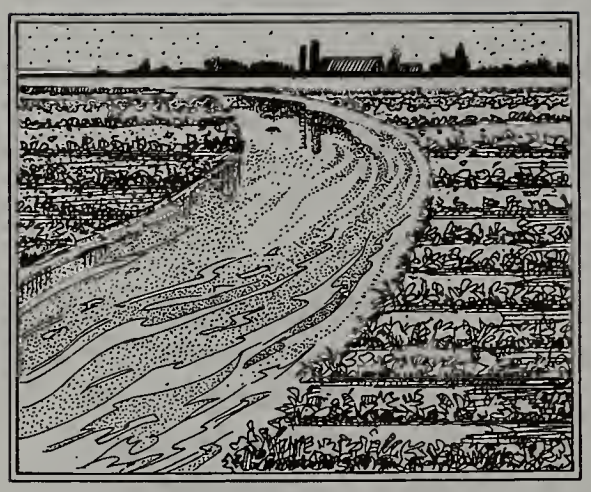
Does a volunteer need any special skills to participate?

Volunteers will be trained to recognize erosion problems associated with each land use, for example, residential, roads, and agricultural use. Volunteers will be taught to read a ***topographic map*** and how to document field findings. Hiking through woods and other types of terrain may be necessary depending on the survey site.

What information is covered in the training?

Training topics include:

- Discussion of watersheds and watershed management tools.
- Nonpoint source pollution — with a focus on soil erosion — and its effects on lake water quality.
- Lake ecology.
- The effects of declining water quality on the local economy.
- Reading topographic maps.



How to use forms associated with the survey.

- ***Site*** documentation.
- Typical land use problems (slide show).
- Communicating with landowners.

What will volunteers be looking for?

Volunteers will look for erosion problems, both small and large. While a small erosion problem may not seem significant, the accumulation of many small problems throughout the watershed can have a serious impact on a lake. Volunteers will look closely at ***stream*** crossings, ditches, and other drainage ways for indicators such as cloudy water and sediment deposits (turbidity). Signs of concentrated stormwater runoff heading toward the lake without being absorbed into the ground also will need to be documented.

When and where will the volunteer start the survey?

Volunteers may begin surveying their sections of the watershed soon after the training session. Ideally, volunteers should complete their surveys within a week after training.

What's it like in the field?

The best way to investigate the watershed is to walk it. Cars may be used to get around within the watershed. Roads will allow volunteers to access to all types of land uses. Be prepared to access private property. The survey should have been well publicized before volunteers are actually in the field, so watershed residents should be aware of volunteers walking their property. This may include a call to property owners, giving dates of the survey and inviting property owners to join you in the survey. At a minimum, be prepared to talk to watershed residents prior to and during the survey.

Be prepared to follow signs of erosion along the waterway. For example, if a turbid stream is located, volunteers may need to hike up the stream to find the source.Volunteers will be documenting what they observe along the way. Instructions on recordkeeping can be found in Section 4 of this guide. Survey forms are found in appendix A.

What should volunteers bring?

Basic materials are needed and most of the items are found at home, such as bad weather gear and flashlights.

What kind of safety issues should be considered?

Volunteers need to take the same common sense safety precautions taken if going on a day hike. For example, take a first-aid kit, a map, and bring water and snacks. A detailed checklist is found in Section 4 of this guide.

Who will be in the field with the volunteer?

Surveyors need to work in teams of two or more. It's safer than being alone, and volunteers will be able to discuss observations.

Who can volunteers go to with questions?

There should be a coordinator among the volunteers. This person's responsibilities include acting as a point of contact for surveyors, steering committee members, and technical advisors; providing volunteers with forms and watershed area maps; collecting documentation sheets from volunteers when they have completed the survey; making sure the sheets are properly filled out; and sending the documentation sheets on to the technical advisors.

How many people will be involved?

The number of volunteers involved depends on the size of the watershed. Other factors include the density of the developed areas and the amount of time the volunteers are willing to spend on the project. The more volunteers there are, the less time each volunteer will need to spend surveying. Typically, eight to twelve volunteers are sufficient.

What do volunteers do first when they get into the field?

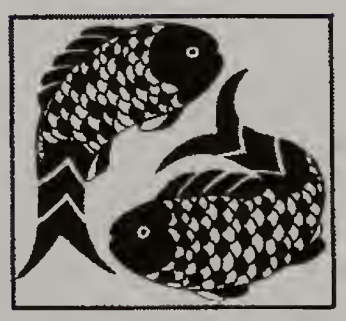
Volunteers should become familiar with their section of the watershed on the topographic map. Locate the roads and the boundaries of the watershed and decide where to begin.

Will volunteers get follow-up information about the survey?

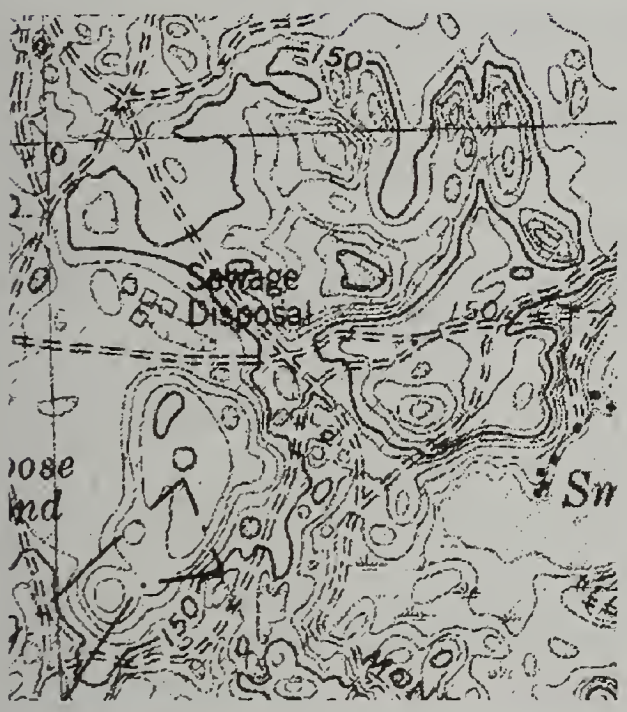
Yes. A report of survey findings will be prepared by the project's coordinators as soon as the field survey is completed. They'll give the report to field volunteers, town officials, and the press. The initial report will present an overview of the extent of phosphorus and sediment problems in the lake watershed and will summarize the problems by category and priority.

Who will pay to address the problems identified in the survey?

Funding sources for problems are found in Appendix D.



Finding Your Way: A Guide to Reading Maps



Knowing how to read a United States Geological Survey (USGS) topographic (topo) map is critical to conducting your lake watershed survey in the field. You will be navigating with and marking sites on a topographic map. Once you learn to read a topo map, you'll be able to recognize, by looking at the map's contour lines, steep slopes, valleys, streams, hills, and other topographic features. You will also be able to find your way around various locations.

What is a Topographic Map?

A topographic map tells you where things are and how to get to them. These maps describe the shape of the land. They define and locate natural and manmade features like woodlands, waterways, important buildings, roads, and bridges. They show the distance between any two places, and they also show the direction from one point to another.

Resources

There are many helpful web sites available to obtain topographic maps as well as to find detailed information on how to read maps. Here are some of them:

United States Geological Services: http://www.usgs.gov

What is a Topographic Map? http://mapping.usgs.gov/mac/isbpubs/booklets/symbols/index.html

Finding Your Way with Map and Compass Fact Sheet. http://mapping.usgs.gov/mac/isb/pubs/factsheets/fs07999.html

Working with Maps: How to Read a Topographic Map. http://www.usgs.gov/education/teacher/what-do-maps-show/WDMSa4.html

Information Products about Mapping and Related Subjects. http://www.usgs.gov/mac/isb/pubs/pubslists/index.html

Understanding Map Scales. http://mapping.usgs.gov/mac/isb/pubs/factsheets/fs05698.html

MA. Pond Maps Online. http://www.state.ma.us/dfwele/dfw/dfw_pond.htm

Others

Introduction to Orienteering: The Map. http://www.williams.edu/biology/orienteering/map.html

Silva Compasses: Read This or Get Lost. http://www.silvausa.com/camping/silva/silva.html

How to Obtain or Purchase Topographic Maps

By Internet

http://www.topozone.com
http://wwmapping.usgs.gov/esic/map_dealers/ma./html
http://umass.edu/tei/esio

By E-mail
businesspartners@usgs.gov

By Telephone
1-888-MAP-DEAL

Common Map Symbols

Intermittent stream

Intermittent river

Disappearing stream

Perennial stream

Perennial river

Perennial lake;
Intermittent lake or pond

Marsh or swamp

Submerged marsh or swamp

Submerged wooded
marsh or swamp

Building

School; church

Well; windmill

Primary highway

Light duty road

Trail

Bridge

Tanks

Covered reservoir

Landmark object
(featured as labeled)

Reading Topographic Maps

Map Symbols and Features

Distances and directions take a bit of figuring, but the topography and features of the land are easier to determine.

Interpreting the colored lines, areas, and other symbols is the first step in using topographic maps. Features are shown as points, lines, or areas, depending on their size and extent. For example, individual houses may be shown as small black squares. For larger buildings, the actual shapes are drawn. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps, post offices, churches, city halls, and other landmark buildings are shown within the tinted area.

The first features usually noticed on a topographic map are the area features such as vegetation (green), water (blue), some information added during the map updating (purple), and densely built-up areas (gray or red).
Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination.

The color of the lines usually indicate similar features or classes of information:

Brown - topographic contours
Blue - lakes, ponds, streams, and irrigation ditches.
Green - vegetation
White - cleared areas such as fields, developed areas, and farmland
Red - land grids and important roads
Black - other roads and trails, railroads, and boundaries.
Purple - updated features using aerial photography, but not field verified.
Gray or Pink – urban areas

Various symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells. Some of the more common map symbols are shown on this page. More can be found on the USGS web site (see page C-65).

Names of places and features also are shown in a color corresponding to the type of feature. Labels, such as "Substation" or "Golf Course" identify many features.

Ground Configuration Shown by Contour Lines

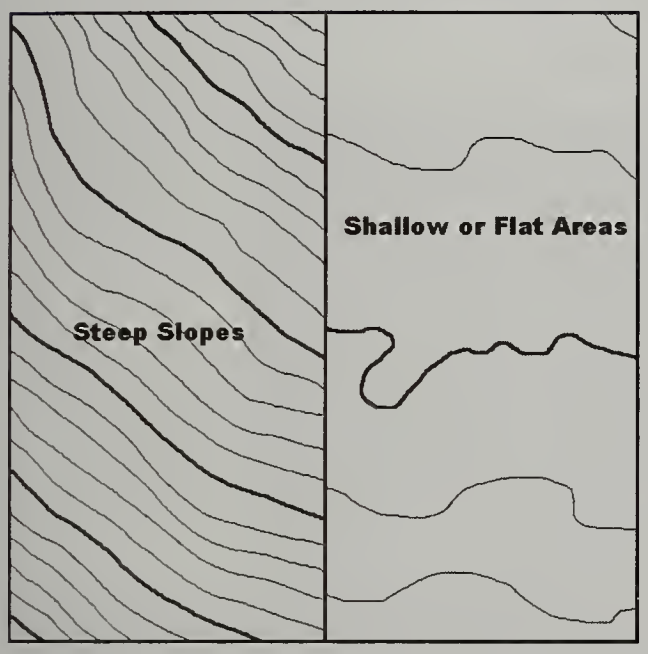


Figure 1: Contour lines that are closely spaced represent steep slopes, and those that are widely spaced, or the absence of contours, represent shallow or flat areas.

Topographic contours are shown as brown lines of different widths. They show the general shape of the terrain. To help the user determine elevations, index contours (usually every fourth or fifth contour) are wider. The narrower intermediate and supplementary contours found between the index contours help to show more details of the land surface shape.

- *Contour lines connect points of equal elevation. These lines never cross.*
- *Elevation is expressed in feet above sea level. It appears on contour lines, and on the summit of hills and mountains, and the surface of many ponds and lakes.*
- *The elevation difference between adjacent contour lines is called the contour interval. Contour intervals are usually mapped at 10 or 20 feet (which means the change in elevation between contour lines is 10 or 20 feet).*
- *Lines that connect the tops of hills and ridges form watershed boundaries.*
- *The top of the maps is always north and the bottom is always south.*
- *The right side of the map is always east and the left side of the map is always west.*

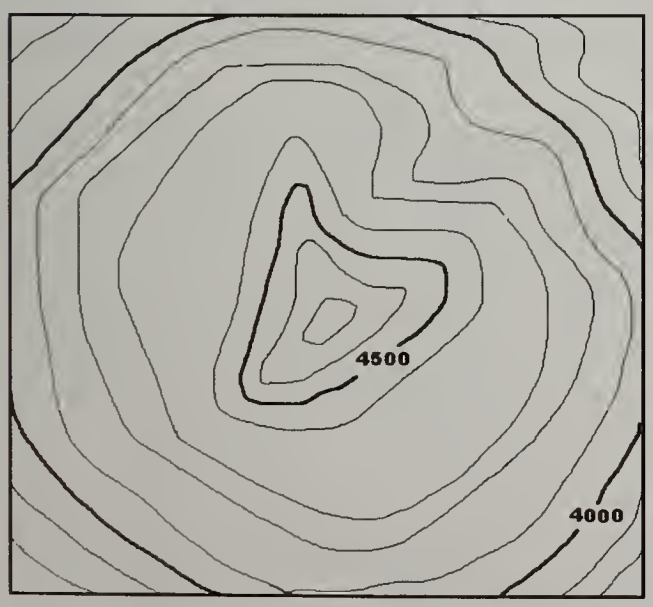


Figure 2: Hills and mountains appear as a series of successively smaller concentric circles. The circles are usually irregularly shaped and the smallest circle at the top represents the highest point of the land.

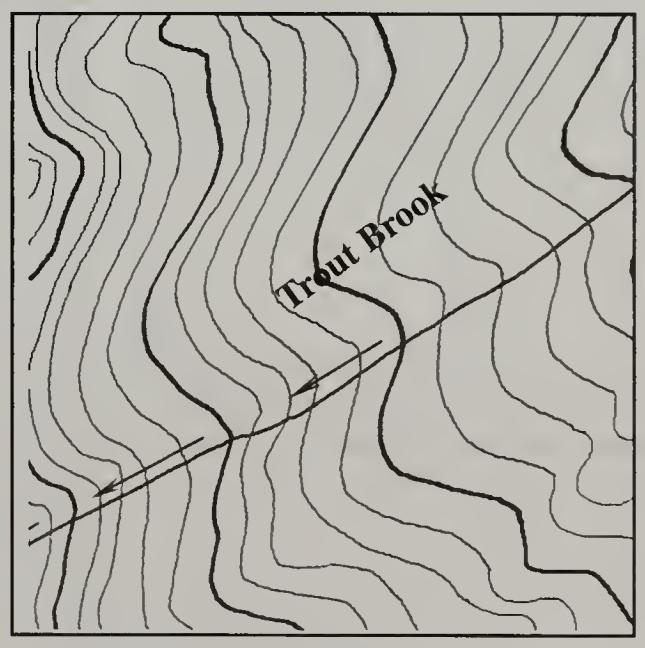


Figure 3: The "V" formed by contour lines that cross a stream always points upstream, or against the flow of the stream.

Ground Configuration Shown by Contour Lines

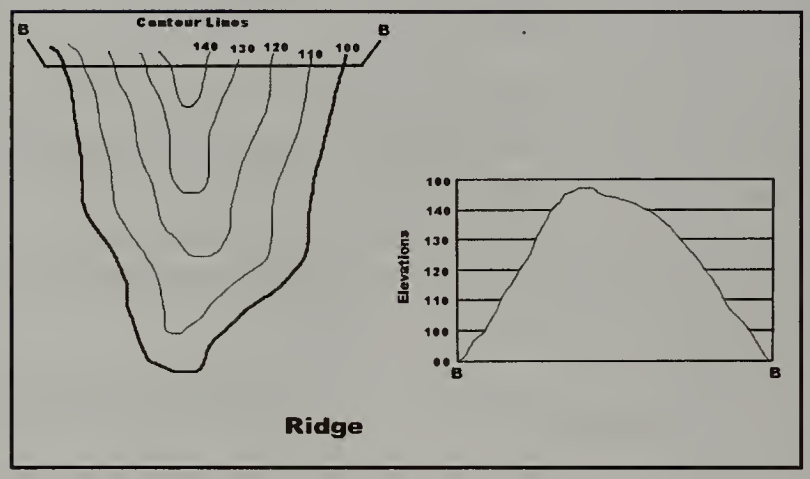


Figure 4b: Contour lines that represent a ridge are also V- or U-shaped, but the point of the "v" indicates the lower elevations.

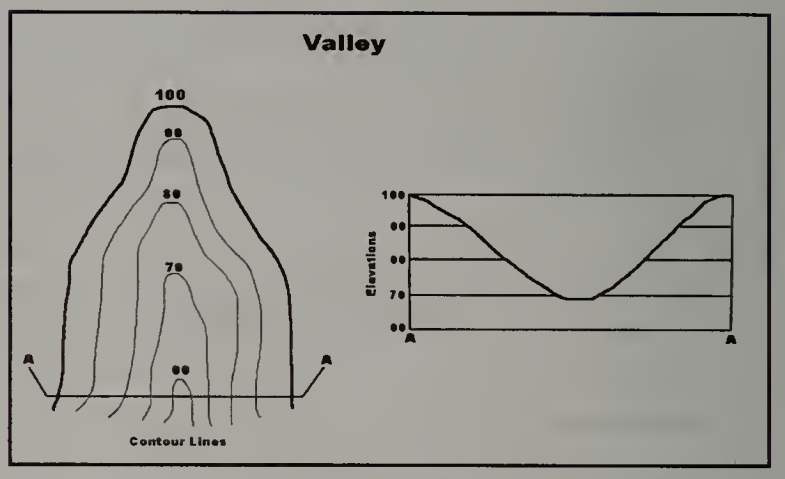
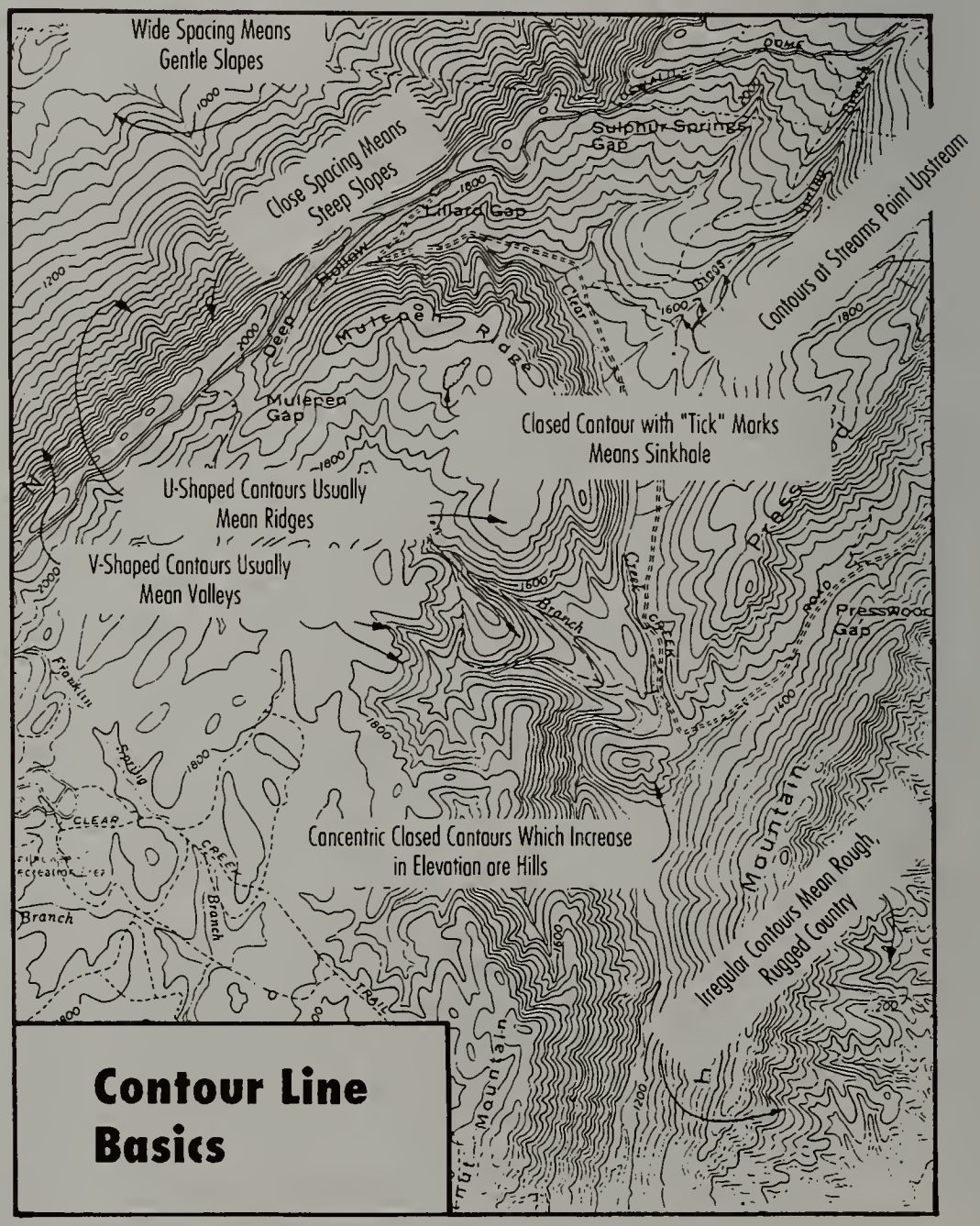


Figure 4a: Contour lines that represent valleys, or depressions in terrain are usually V- or U-shaped, and the point of the "V or U" indicates the higher elevation.

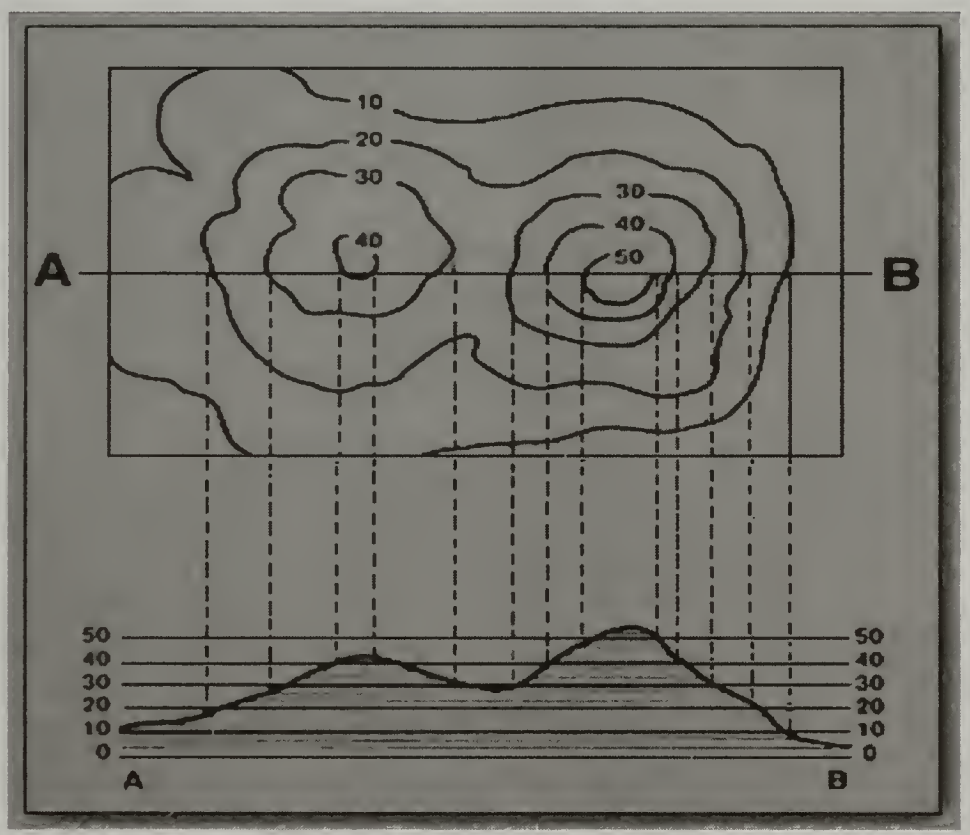
Figure 5: When two streams converge, the "V" formed point where the two streams intersect points downstream.


Wide Spacing Means Gentle Slopes
Close Spacing Means Steep Slopes
Sulphur Springs Gap
Lillard Gap
Streams Point Upstream
Contours of Streams
Closed Contour with "Tick" Marks Means Sinkhole
U-Shaped Contours Usually Mean Ridges
V-Shaped Contours Usually Mean Valleys
Concentric Closed Contours Which Increase in Elevation are Hills
Irregular Contours Mean Rough, Rugged Country
Mulepen Gap
Pressw Gap
Contour Line Basics

Drawings reprinted with permission from Air & Waste Management Association's ***Environmental Resource Guide (ERG) — Nonpoint Source Pollution Prevention for Grades 9-12,*** copyright, 1993; Air & Waste Management Association, Pittsburgh, PA 15222.

Understanding Contour Lines Activity

Contour lines on a topographic map show the shape and elevation of the land. They are sometimes called level lines because they are at the same level. Here's how contour lines work:



The top of this drawing is a contour map showing the hills that are illustrated at the bottom.

On this map, the vertical distance between each contour line is 10 feet.

1) Which is higher, hill A or hill B?_____

2) Which is steeper, hill A or hill B?_____

3) How many feet of elevation are there between contour lines?_____

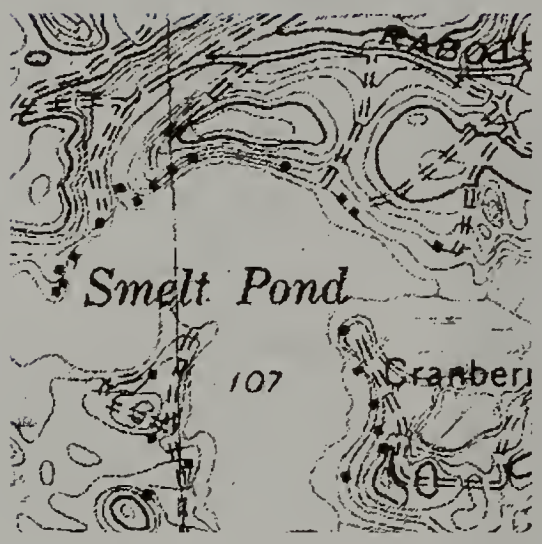
4) How high is hill A?_____ Hill B?_____

5) Are the contour lines closer together on hill A or hill B?_____

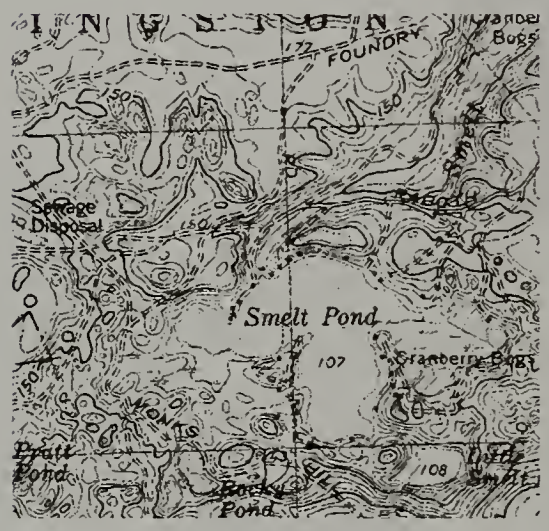
Answers:

1) Hill B
2) Hill B
3) 10 feet
4) Hill A is 40 feet; Hill B is 50 feet
5) Hill B has closer contour lines

Map Scales: The Larger the Number; the Smaller the Scale



Smelt Pond, MA 1:5,000



Smelt Pond, MA 1:10,000

Smelt Pond, MA 1:15,000

To be most useful, a map must show locations and distances accurately on a sheet of paper of convenient size. This means that everything included in the map – ground area, rivers, lakes, roads, distances between features, and so on – must be shown proportionately smaller than they really are. The proportion chosen for a particular map is its scale.

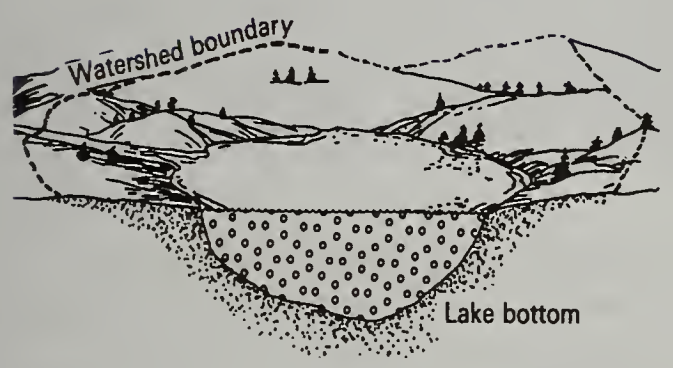
Simply defined, scale is the relationship between distance on the map and distance on the ground. A map scale might be given as a drawing (a graphic scale), but it usually is given as a fraction or a ratio – 1/10,000 or 1:10,000.

These "representative fraction" scales mean that one unit of measurement on the map – 1 inch or 1 centimeter – represents 10,000 of the same units on the ground. If the scale were 1:63,360, for instance, then 1 inch on the map would represent 63,360 inches or 1 mile on the ground (63,360 inches divided by 12 inches equals 5,280 feet or 1 mile). The first number (map distance) is always 1. The second number (ground distance) is different for each scale**; the larger the second number is, the smaller the scale of the map.**

U.S. Geological Survey Scales

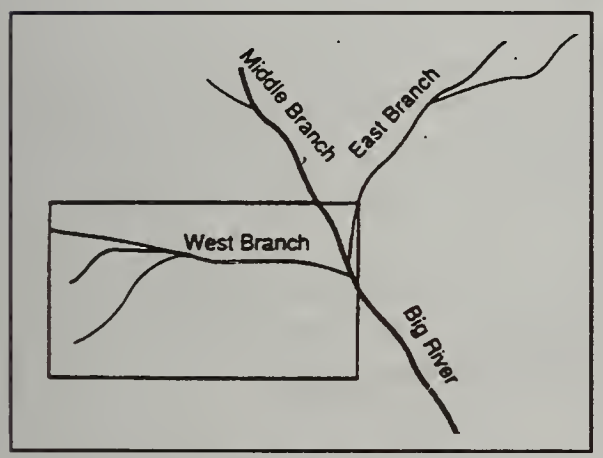
The U.S. Geological Survey (USGS) publishes maps at various scales. The scale used for most United States topographic mapping is 1:25,000. USGS maps at this scale cover an area measuring 7.5 minutes of latitude (north to south lines) and 7.5 minutes of longitude (east to west lines) and are commonly called 7.5-minute quadrangle maps. Maps at 1:25,000 scale are fairly large and provide detailed information about features of an area, including the locations of important buildings, footbridges; drawbridges, fence lines, and private roads are also shown at this scale.

Finding the Boundaries of a Watershed



Imagine a watershed as an enormous bowl. As water falls onto the bowl's rim, it either flows down the inside of the bowl or down the outside of the bowl. The rim of the bowl or the watershed boundary is sometimes referred to as the ridge line or watershed divide. This ridgeline separates one watershed from another.

Topographic maps with the scale of 1:25,000 (which means that one inch measured on the map represents 25,000 inches [2000 feet] on the ground) can help you determine a watershed's boundaries.

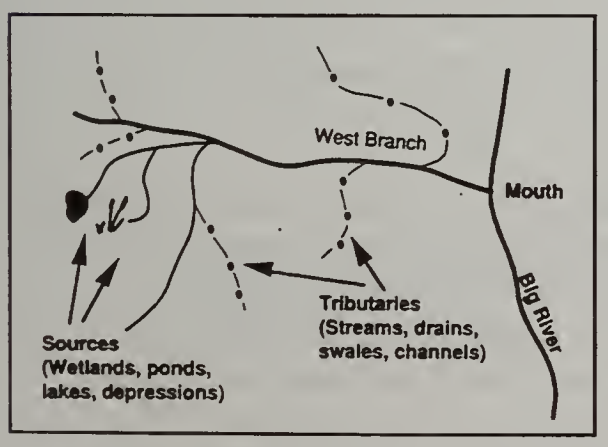


1) Big River Watershed

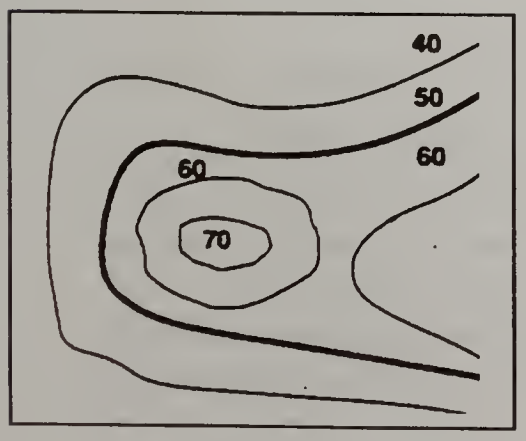
They also have contour lines that are usually shown in increments of ten or twenty feet. Since each contour is a line of elevation, the water that flows downhill would cross the contour lines perpendicularly.

Here's how you would delineate a watershed:

1) Use a topographic map(s) to locate the river, lake, stream, wetland, or other waterbodies of interest.



2) West Branch Subwatershed



3a) Contour Lines

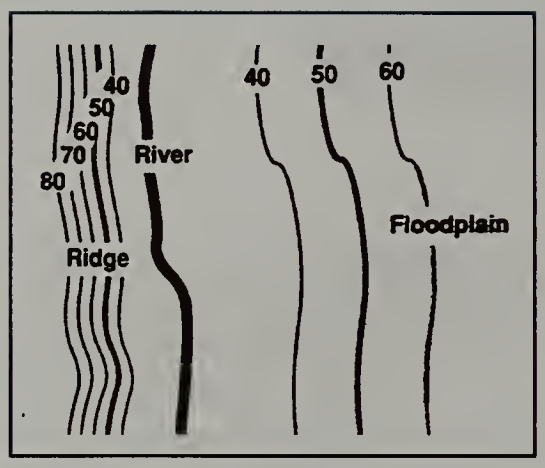
2) Trace the watercourse from its source to its mouth, including tributaries. This step determines the general beginning and ending boundaries.

3) Examine the contour lines on the topographic map that are near the watercourse. Contour lines connect all points of equal elevation above or below a known reference elevation.

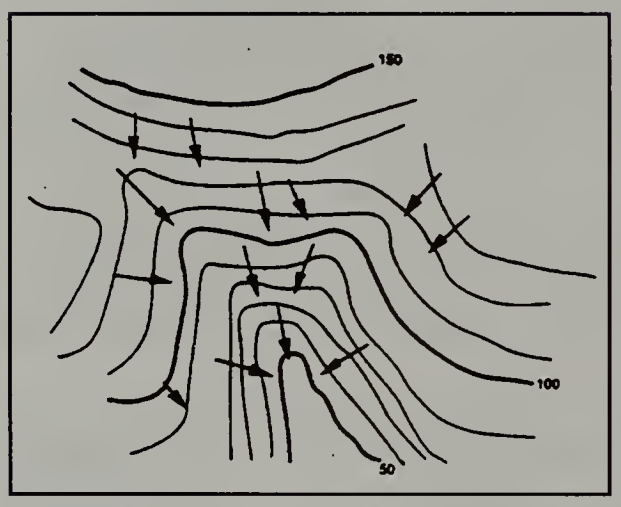
A. The index contour lines (dark brown thick lines) will have an elevation associated with them and are usually mapped at 50 feet intervals. The light brown thin lines, intermediate or supplementary contours, are usually mapped at 10 feet intervals. To determine the final elevation of your location, simply add or subtract the appropriate contour interval for every light brown (thin) line, to the appropriate interval for every dark brown (thick) line.

B. Contour lines spaced far apart indicate that the landscape is more level and gently sloping. Contour lines spaced very close together indicate dramatic changes (rises or fall) in elevation over a short distance.

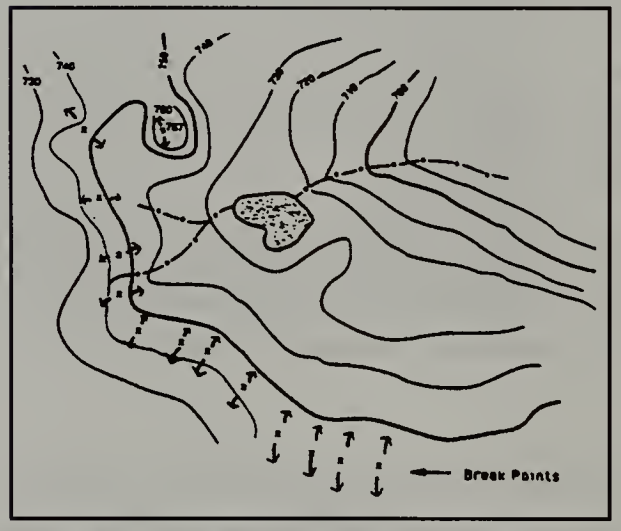
4) Check the slope of the landscape by locating two adjacent



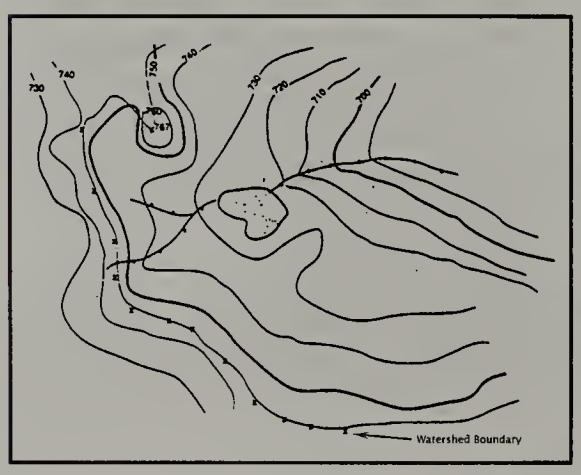
3b) Floodplains and Ridges



5) Direction of Drainage



6) Identify Break Points



7) Watershed Boundary

contour lines and determine their respective elevation. The slope is calculated as the change in elevation divided by the distance.

a. A depressed area (valley, ravine, and swale) is represented by a series of contour lines "pointing" towards the highest elevation.
b. A higher area (ridge, hill) is represented by a series of contour lines "pointing towards the lower elevation.

5) Determine the direction of drainage in the area of the waterbody by drawing arrows perpendicular to a series of contour lines that decrease in elevation. Stormwater runoff seeks the path of least resistance as it travels down slope.The "path" is the shortest distance between contours hence a perpendicular route.

6) Mark the break points surrounding the waterbody. The "break points" are the highest elevation where half of the runoff would drain towards one body of water, and the other half would drain towards another body of water.

7) Connect the break points with a line following the highest elevations in the area. The completed line represents the boundary of the watershed.

a. Mark the watershed boundary along break points. For lakes which have an outlet, begin at the outlet and draw the watershed divide lines perpendicular to the contour lines until the watershed line to the outlet meets the larger watershed divide usually located along a ridge line. Repeat for the other side of the outlet.

8) Once you've outlined the watershed boundaries on your map, imagine a drop of rain falling on the surface of the map. Imagine the water flowing down the slopes as it crosses contour lines at right angles. Follow its path to the nearest stream that flows to the waterbody you are studying. Imagine this water drop starting at different points on the watershed boundaries to verify that the boundaries are correct.

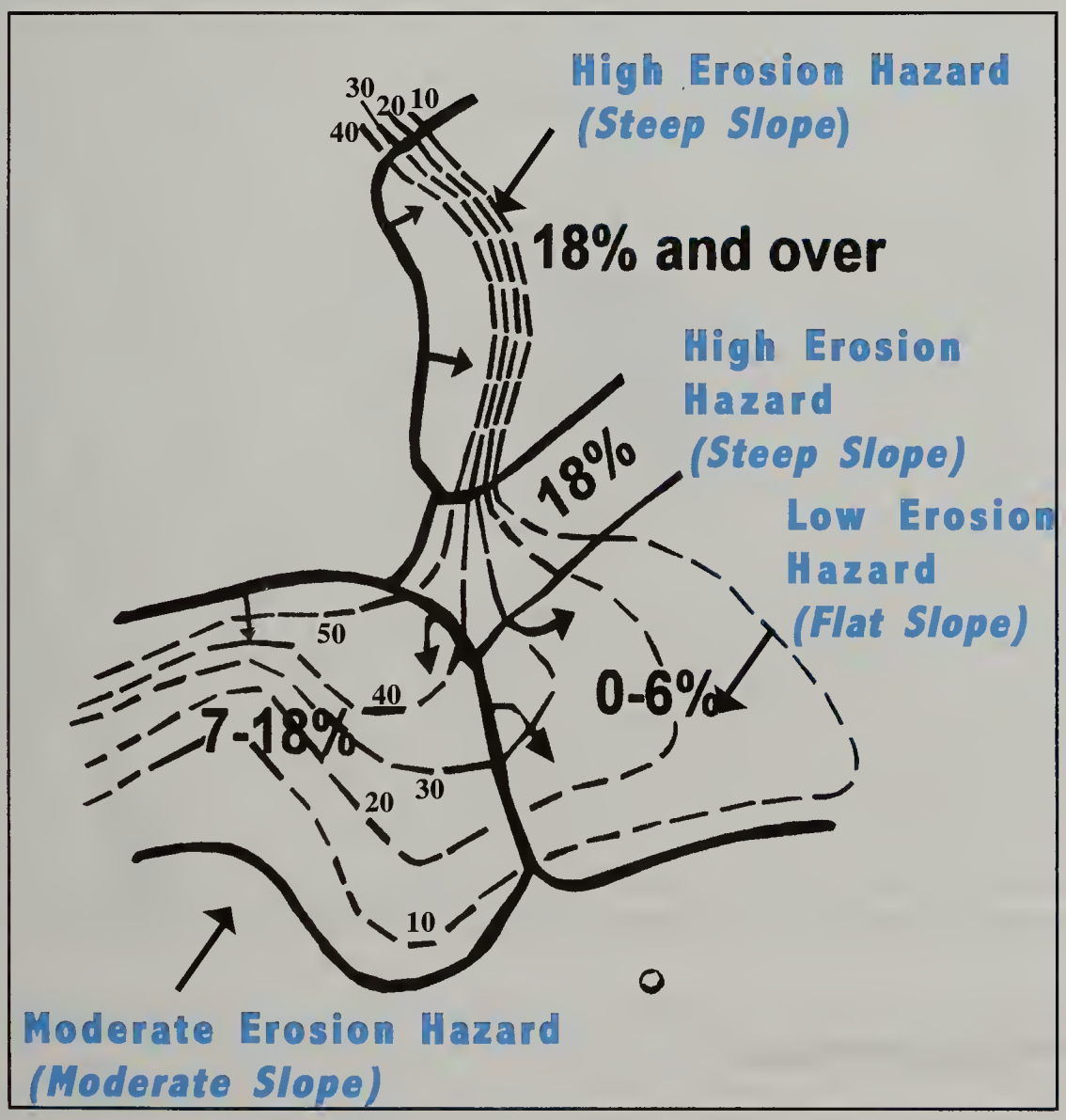
9) Distribute copies of your watershed map to your group.

10) Your watershed map can be further divided into smaller sections or subwatersheds. The surveyors will be responsible for studying the subwatersheds in the field.

11) Once the watershed and the subwatershed boundaries have been delineated on the map, your team can verify them in the field.

Determining the Slope Condition for the Survey Site

When conducting your lake watershed survey and filling out your survey form, you will need to determine if slope conditions are low, moderate, or high erosion hazards. The graphic below, using contour lines, should give you a better idea of how to determine that. This is a graphic representation of a topographic map. Contour lines spaced close together represent steep slopes. Contour lines spaced far apart represent flat slopes and contour lines in between represents moderate slopes.

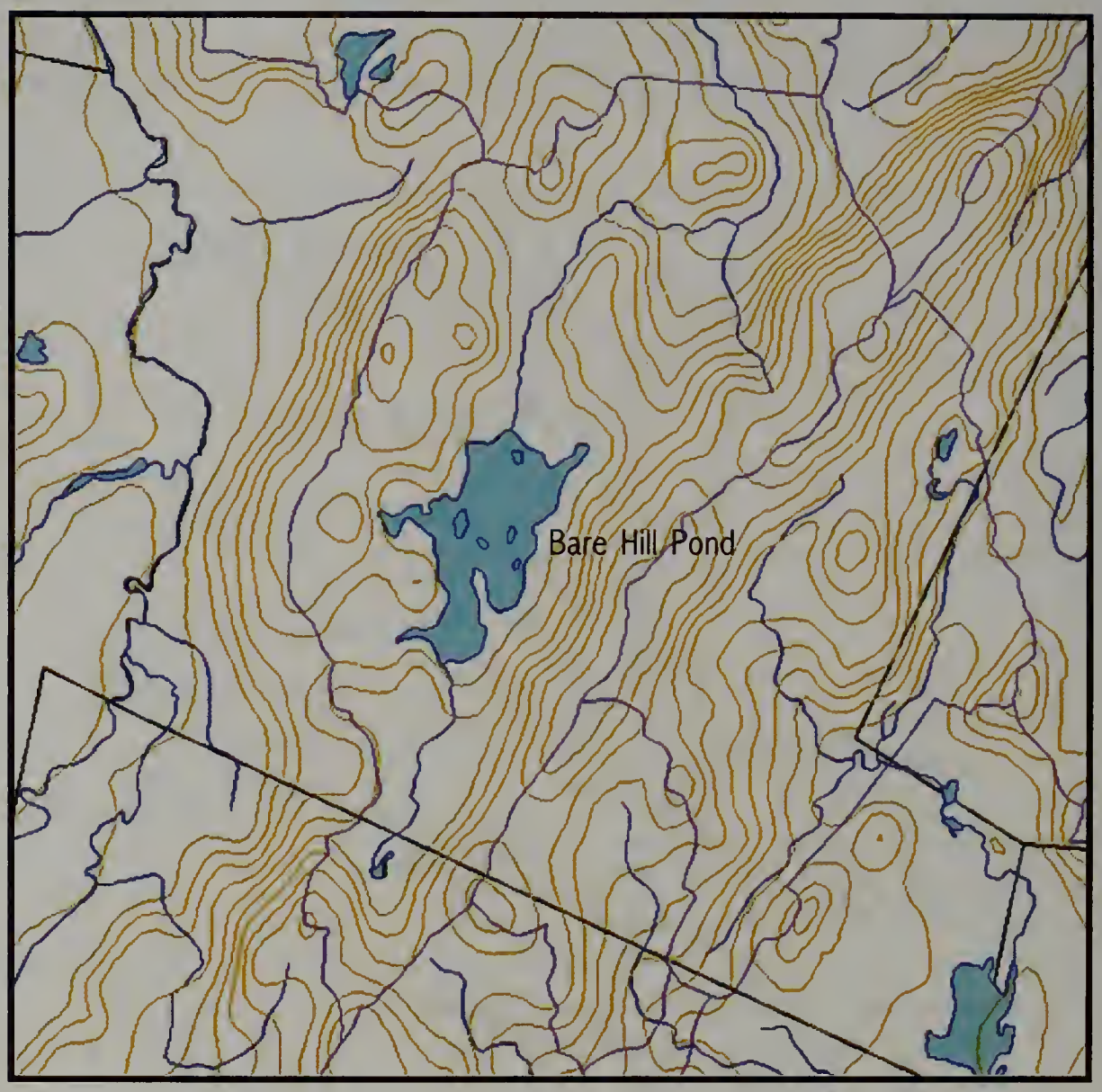


0-6% Slope = Low Erosion Hazard *(contour lines spaced far apart - flat slope).*

7-18% Slope = Moderate Erosion Hazard *(moderate slope).*

18% and Over = High Erosion Hazard *(contour lines spaced close together - steep slope).*

Bare Hill Pond Sub-basin



0.5 0 0.5 1 1.5 2 Miles

Sub-basins
30 Foot Contours
Major Basins
100k Rivers and Streams
100k Lakes and Ponds

N
W
E
S

Funding Opportunities and Resources

The following funding opportunities and resources are available for lake watershed surveys and implementation of remediation measures. Contact agencies directly for details on grant applications and deadlines. Contact names, addresses, and telephones numbers may change. They are current up to the printing of this document. Check the agency/organization Web sites for the most up to date information.

State and Local Grants

Source: Massachusetts Department of Environmental Management

DEM offers grants for a variety of conservation management projects including those that promote the preservation, protection, and public use of lakes, ponds, and shorelines of waterways. Applicants can include municipalities, non-profit organizations, and planning agencies. For more information, contact the individual grant contacts, or visit DEM's Grants Section Web site at http://www.state.ma.us/dem/grants.htm.

Lakes and Ponds Grant Program
Steve Asen (617) 973-8733

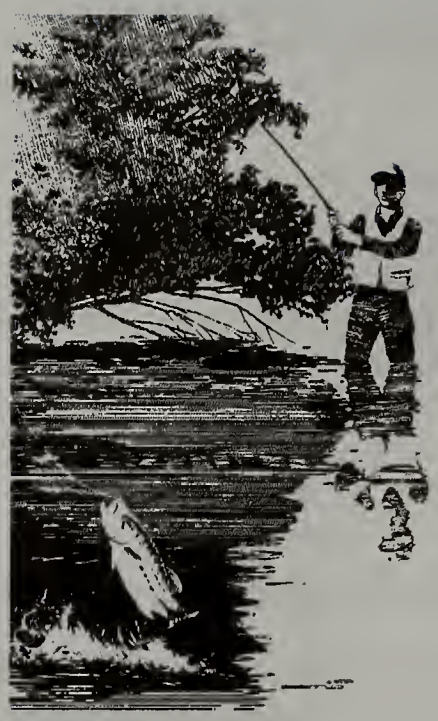
Promotes a holistic approach to lake management based on scientific principles and emphasizes the integrated use of watershed management, in-lake management, pollution prevention, and education to provide long-term solutions to lake problems. Priority is given to lake districts, lake associations, and other active citizen groups, as well as to proposals that develop and enhance public access to the waterbody and public uses.

Greenways and Trails Demonstration Grants Program
Jennifer Howard (413) 586-8706 Ext. 18

Greenways are corridors of land and water that protect and link a variety of natural, cultural, and recreational resources. Grant awards of $1,000-$5,000 may be given to municipalities, non-profit organizations, and regional planning agencies to support innovative projects which create and/or promote greenways and trail networks in Massachusetts.

MASS ReLeaf Grant Program
Edith Makra (617) 626-1466

Fosters partnerships between business, government, and nonprofit groups to raise money for the planting and care of public trees. The program helps communities purchase trees for energy conservation, screening, community gateway or parking lot enhancement, or to offset urban pollution. The program also engages a network of community leaders, government officials, and corporate partners through educational and promotional events and projects. In addition, the program assures long-term tree survival by



emphasizing proper tree selection, planting, aftercare, and maintenance. Applicants can be municipalities and non-profit organizations that will plant trees on publicly accessible land. The grants require in-kind services such as planting and maintenance of trees. Up to $5,000 in grant funds are available to each recipient.

National Recreational Trails Act Grant Program
Peter Brandenburg (617) 973-8740

Under the National Recreational Trails Act (NRTA) and the Intermodal Surface Transportation Act (ISTEA) of 1991, fuel tax revenues, generated by off-highway vehicles and backcountry camping, are used to fund trail projects conducted by private organizations, government agencies, and municipalities. Projects can include mitigation of erosion problems of trails that abut waterbodies.

Forest Stewardship Planning and Project Grants for Town Forestlands
Susan Campbell (413) 256-1201

Encourages landowners to practice long-term guardianship through development of management plans for woodlands. The program is designed to improve wildlife habitat and forest aesthetics, to protect soil and water resources, and to increase the potential for high-quality wood products. Grants are awarded to public and private organizations in three categories: landowner outreach projects that deliver a stewardship message, such as tours, workshops, demonstrations, and printed material; preparation of 10-year forest management plans and demonstration areas on town and conservation commission lands; and professional training and technical support to the forestry community for delivery of a stewardship message. Most grants range from $500 to $2,500.

Urban Forest Planning and Education Grants
Warren Archey (413) 784-1829 Ext.33 or Edith Makra (617) 626-1466

Assist communities and nonprofit groups in building support for long-term protection and management of community trees and forests. Grants are awarded to tree wardens and nonprofit groups to organize and develop projects with the involvement of local residents and educators. The USDA Forest Service provides the grants, which DEM administers with guidance from the Massachusetts Community Forestry Council. A maximum of $10,000 is available per project.

Rivers and Harbors Grant Program
Leslie Lewis (781) 740-1600

A statewide program of matching grants from DEM's Office of Waterways to towns and municipalities for design and construction to address problems on coastal and inland waterways, lakes, and great ponds. Projects funded under the program include channel and harbor dredging; pier, wharf, bulkhead, seawall, revetment and jetty repairs; coastal erosion control and beach nourishment; inland flood control; river cleanup and streambank stabilization; and other water-related projects. The grants require a 25% local match for dredging, and 50% for all other types of projects. Because there are practical

limits to funding, projects requiring less than $300,000 in state funds are preferred. The program also provides matching funds for the local cost share of U.S. Army Corps of Engineers projects within the Commonwealth.

Source: Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement

Riverways Small Grants Program
Patricia Sheppard (617) 626-1541

Promotes greenways along rivers and healthy stream flows by funding projects that restore rivers and their wildlife and fisheries habitats. Grants range from about $3,000 to $8,000. For more information, see the Web site at www.state.ma.us/dfwele/river/riv_tac.htm.

Source: Massachusetts Department of Environmental Protection

DEP's grant and loan programs include funds from the U.S. Environmental Protection Agency as authorized by the federal Clean Water Act (sections 604b, 104(b)(3) and 319(h) and from state appropriation (research and demonstration and loan programs for municipalities and homeowners). More detailed information can be found at DEP's Web site: www.state.ma.us/dep/brp/wm/wmpubs.htm or by contacting DEP's Regional Service Centers: Northeast: (978) 661-7677; Southeast: (508) 946-2714; Central: (508) 792-7683; and Western: (413) 755-2124.

Grants:

604b Water Quality Management Planning Grant Program funds projects that combine elements of water supply protection and planning and water quality assessment, particularly addressing nonpoint source issues. Proposals should have a public outreach or technology transfer component. Eligible grant recipients include regional planning agencies, councils of governments, conservation districts, counties, and municipalities. A local match is not required, but is encouraged.Contact Gary Gonyea: (617) 556-1152.

319(h) Nonpoint Source Grant Program funds projects that prevent, control, and abate nonpoint source pollution. Projects must have a 40 % non-federal match of the total project cost, which can be cash or in-kind services performed as part of the approved project activities. Lake protection and restoration projects are eligible for funding if they meet the same criteria for remediating nonpoint source pollution. 319(h) projects typically receive $20,000 - $150,000. Lake and pond restoration projects will require additional funding from other sources to implement. Eligible recipients include any interested Massachusetts public or private organization.Contact Beth McCann: (617) 292-5901.

Loan Programs:
Northeast Region: Tom Mahin (978) 661-7660
Southeast Region: Dick Keith (508) 946-2784
Central Region: Paul Andersen (508) 767-2802
Western Region: Dierdre Cabral (413) 755-2148

Clean Water State Revolving Loan Fund (CWSRF) Program
The Massachusetts State Revolving Fund for water pollution abatement projects provides low-cost funding to help municipalities comply with federal and state water quality requirements. The CWSRF Program is jointly administered by DEP's Division of Municipal Services and the Massachusetts Water Pollution Abatement Trust. CWSRF loans have the current subsidy level of 50% grant equivalency that approximates a no-interest loan. Loans are available for planning, design, and construction of structural water pollution abatement projects, nonpoint source pollution abatement projects, and stormwater remediation. Non-structural projects, such as planning projects for remediating nonpoint source problems, also are eligible for funding.

Community Septic Management Program
Provides funds to homeowners with failing septic systems to comply with the Title 5 regulations. Communities can obtain loans for septic system planning and improvements.

Massachusetts Drinking Water State Revolving Fund (DWSRF) Program
Provides loans to municipalities for engineering, design, and construction of drinking water projects that protect public health and strengthen compliance with federal and state drinking water regulations. The current subsidy level of 50% equivalency approximates a no-interest loan.

Source: Massachusetts Environmental Trust

The Trust is an environmental philanthropy established by the Massachusetts Legislature in 1988. The Trust funds and coordinates projects that encourage cooperative efforts to raise environmental awareness and support innovative approaches to protect and preserve natural resources, with a special focus on water and related land resources of the Commonwealth. There are a variety of grants available through the Trust with different applicant requirements and funding cycles. For more information, contact the Trust at (617) 727-0249, by e-mail at env.trust@state.ma.us, or see the Web site at http://www.agmconnect.org/maenvtr1.html.

Source: Massachusetts Department of Food and Agriculture

The Massachusetts Department of Food and Agriculture's Agricultural Environmental Enhancement Program (AEEP) provides funding to farmers to install a variety of water quality protection practices. Eligible practices include the installation of buffers, animal waste systems, pesticide storage facilties, fencing, culverts, seed and gutters. All farmers who actively farm five acres or more of land which could potentially impact a water resource are eligible. For more information on the program contact the coordinator, Susan Phinney, at (617) 626-1772.

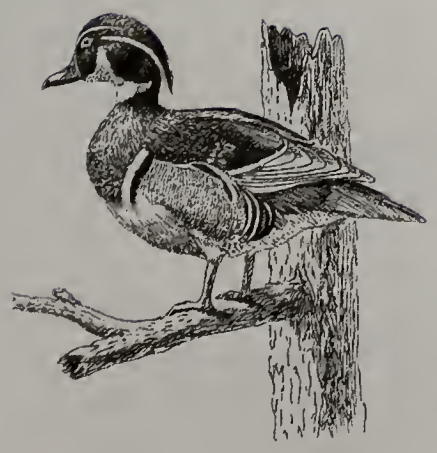
Federal Grants and Resources

Source: U.S. Department of Agriculture, Natural Resources Conservation Services

Watershed Protection and Flood Prevention Program works through local government sponsors to solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, wetlands creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. **Technical and financial assistance** is available for installation of improvement projects to protect, develop, and utilize land and water resources in small watersheds. Applicants can include a local or state agency, county, municipality, soil and water conservation district, flood prevention or flood control district, Indian Tribe or Tribal organization, or non-profit agency with authority to carry out, maintain, and operate watershed improvement works. Funds include cost sharing for 100% of flood prevention costs; and 50% of construction costs related to agricultural water management, recreation, and fish and wildlife. For more information, see the NRCS Web site at http://www.nhq.nrcs.usda.gov, or call the appropriate NRCS Field Office:

State Headquarters – (413) 253-4350
Barnstable Field Office (serving the Cape Cod, Dukes, and Nantucket Conservation Districts) – (508) 771-6476
Greenfield Field Office (serving the Franklin Conservation District) – (413) 772-0384 Ext.3
Holden Field Office (serving the Northeastern, Northwestern, and Southern Worcester Conservation Districts) – (508) 829-4477 Ext.3
Northampton Field Office (serving the Hampden and Hampshire Conservation Districts) – (413) 585-1000 Ext.3
Pittsfield Field Office (serving the Berkshire Conservation District) – (413) 443-6867 Ext.3
West Wareham Field Office (serving the Bristol, Norfolk, and Plymouth Conservation Districts) – (508) 295-5151 Ext.2
Westford Field Office (serving the Essex, Middlesex, and Suffolk Conservation Districts) – (978) 692-1904 Ext.3

Environmental Quality Incentives Program (EQIP) is a conservation grants program for farmers whose properties face serious threats to soil, water, and related natural resources. The program provides technical, financial, and educational assistance in designated priority areas such as watersheds, regions, or areas of special environmental sensitivity or having significant soil, water, or related natural resource concerns. These concerns include soil erosion, water quality and quantity, wildlife habitat, wetlands, and forest and grazing lands. The program pays for up to 75% of cost sharing expenses for conservation practices that improve and maintain the health of the natural resources in the area.



Wetlands Reserve Program (WRP) restores and protects wetlands on private property. WRP provides landowners with financial incentives to enhance wetlands in exchange for retiring marginal agricultural land. Landowners may sell a conservation easement or enter into a cost share restoration agreement.

Landowners and NRCS develop a plan for restoration and maintenance of the wetland. Applicant must be a landowner for at least one year and the land must be restorable and suitable for wildlife benefits. NRCS provides from 75 to 100% of the restoration costs depending on the easement and agreement with the landowner.

Source: U.S. Department of Interior, U.S. Fish and Wildlife Service

The North American Wetlands and Conservation Act Grant Program promotes long-term conservation of North American wetland ecosystems, the waterfowl and other migratory birds, fish, and wildlife that depend on that habitat. The program supports the acquisition, enhancement, and restoration of wetlands and wetlands-associated habitat. The program also encourages voluntary, public-private partnerships to conserve North American wetland ecosystems by creating an infrastructure and providing a source of funding. Funding is available for any individual or organization with a long-term wetlands conservation project for acquisition, restoration, and/or enhancement with the required 1:1 partnership match. There are two grants available under the Act. The **Standard Grants Program** funds projects that provide long-term conservation of wetlands and associated uplands through habitat protection, restoration, or enhancement. The funding cap is $1 million per grant. The **Small Grants Program** gives priority to applicants who have never received an Act grant. The funding cap is $50,000 per grant. For more information, see the U.S Fish and Wildlife Web site at http://www.fws.gov.

Source: U.S. Department of Transportation

Transportation Enhancement Act of the 21st Century funds for water quality projects. The Planning and Conservation League (PCL), Heal the Bay and Rails-to Trails Conservancy developed an EPA sponsored document titled, ***"Merging Currents: Transportation and Water Quality, a Guidebook for Funding Opportunities."*** This booklet explains how local agencies can apply for TEA21 (Transportation Enhancement Act of the 21st Century) funds for water quality projects that are impacted by transportation systems. While geared for California applicants, much of the information is applicable nationwide. PCL sells the booklet for $15. They can be reached at:
PCL Foundation
Publications Office
926 J St. Suite 6112
Sacramento, CA. 95816
(916) 444-8726

Private Trusts and Foundations

Sweet Water Trust is dedicated to the conservation of natural ecosystems and provides grants from its own endowment. It also may allocate grants from other foundation sources. The **Watershed Action Program** provides grants from $1,000 to $10,000 to non-profit organizations that support local action-

oriented projects to improve the ecological health and biotic integrity of local watershed ecosystems, particularly shoreline buffer zones and associated uplands where land and water meet. Types of projects eligible for funding include: acquisition of land or easements; assessment, maintenance, or improvement of water quality and quantity essential to aquatic ecosystem functions; and the prevention, removal, or control of exotic invasive species. Projects also may support good local planning; identify, map, and mitigate nonpoint sources of pollution; support conservation policy and advocacy regarding vernal pools, buffer zone areas, instream flow rates, anadromous fish migration, and dam removals; identify and map natural communities, habitat analysis, or ecological restoration. For more information, contact Sigrid Pickering, Watershed Action Program Director, at (617) 492-5998 or by e-mail at watersweet@aol.com.

FishAmerica Foundation provides grants for fishery improvement projects such as habitat improvement, streambank stabilization, aeration systems, silt removal, planting of trees and vegetation, hatchery construction and renovation, stocking and rearing fish, litter cleanups, and prevention and hands-on education. Non-profit organizations can apply with a letter of support from the appropriate state resource agency. For more information see the Foundation Web site at http://www.asafishing.org/outreach/fish_america.htm.

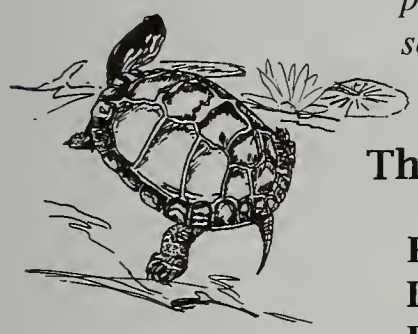
Web Resources

Below are Internet resources and Web sites that deal with non point source pollution, erosion control, watershed management, and related issues.

National Wildlife Federation	www.nwf.org
U.S. Geological Services	www.usgs.gov
U.S. Department of Agriculture	www.usda.gov
Agriculture Research Service	www.ars.usda.gov
Natural Resources Conservation Service	www.nrcs.usda.gov
Forest Service	www.fs.fed.us
U.S. Department of Commerce	
National Oceanic and Atmospheric Administration	www.noaa.gov
U.S. Department of Interior	
Bureau of Land Management	www.blm.gov/education/education.htm
- Environmental Education Programs	
Fish & Wildlife Service	www.fws.gov
U.S. Environmental Protection Agency	www.epa.gov
Envirofacts	www.epa.gov/enviro/index.html
Surf Your Watershed	www.epa.gov/surf or www.epa.gov/nwapsurf
Nonpoint Source Homepage	www.epa.gov/OWOW/NPS
TMDL Homepage	www.epa.gov/OWOW/TMDL
Commonwealth of Massachusetts	www.state.ma.us
Executive Office of Environmental Affairs	www.state.ma.us/enviro
Department of Environmental Protection	www.state.ma.us/dep
Department of Environmental Management	www.state.ma.us/dem
Department of Fisheries, Wildlife and Environmental	
Law Enforcement	www.state.ma.us/dfwele
Massachusetts Ponds On-line	www.state.ma.us/dfwele/dfw/dfw_pond.htm
Massachusetts Municipal Association	www.mma.org
Lakes and Watershed Related Organizations	
Massachusetts Congress of Lakes and Ponds	www.colap.com
Massachusetts Lake and Pond Association -West	
North American Lake Managers Society	www.nalms.org
Massachusetts Water Watch Partnership	www.umass.edu/tei/mwwp
Massachusetts Water Resources Research Center	www.umass.edu/tei/wrrc
Coop Extension	www.umass.edu/umext
Massachusetts Watershed Coalition	www.ultranet.com/~mwc/index.html
River Network	www.rivernetwork.org/~rivernet
Merrimack River Watershed Council	www.merrimack.org
Charles River Watershed Association	www.crwa.org
Nashua River Watershed Association	www.ultranet.com/~nrwa
Citizen Monitoring	
Global Rivers Environmental Education Network	www.earthforce.org/green
U.S. EPA Volunteer Monitoring	www.epa.gov/owow/monitoring/volunteer/startmon.html
Other Useful Sites	
Earth Times: environmental news daily	www.earthtimes.org
Environmental Information Resources	www.gwu.edu/~greenu/index2.html
American Society of Civil Engineers, BMP database	www.asce.org/peta/tech/nsbd01.html

Contacts: Agencies & Organizations

A number of agencies and organizations can provide experience, guidance, and direction in your lake survey work. The following are examples of the resources provided by key organizations that are not listed under "Funding" in this appendix section. Individual contact information is current up to the date of document printing



The Executive Office of Environmental Affairs Watershed Teams

Robert O'Connor
Director of Watersheds and Land Policy
251Causeway Street, 9th Floor
Boston, MA 02114
(617) 626-1170

Karl Honkonen
Watershed Manager
251Causeway Street, 9th Floor
Boston, MA 02114
(617) 626-1138

Boston Harbor Watershed

***EOEA Team Leader*: Karl Pastore**
251Causeway Street, 1st Floor
Boston, MA 02114
(617) 626-1165

DEP Team Leaders
Richard Chretien, NERO
(978) 661-7606
Weymouth/Weir
Sabin Lord, Acting, NERO
(978) 661-7750 Mystic
Richard Chretien, NERO
(978) 661-7606
Neponset

Blackstone Watershed

***EOEA Team Leader*: Lynne Welsh**
180 Beaman Street
West Boyleston, MA 01583
(508) 835-4816 ext. 503

DEP Team Leader
Robert Kimball, CERO
(508) 792-7650 x 3722

Buzzards Bay Watershed

***EOEA Team Leader*:** David Janik
20 Riverside Drive
Lakeville, MA 02347
(508) 946-8990

DEP Team Leaders
Jeffrey Gould, SERO
(508) 946-2757
John Viveiros, SERO
(508) 946-2859

Cape Cod Watershed

***EOEA Team Leader*:** Patti Kellogg
EOEA, Waquoit Bay National Estuary Reserve
P.o. Box 3092
Waquoit, MA 02536
(508) 457-0648

DEP Team Leaders
Elizabeth Kouloheras SERO
(508) 946-2810
Cynthia Martin, SERO
(508) 946-2773

Charles River Watershed

***EOEA Team Leader*:** Peter Phippen
251Causeway Street, 9th Floor
Boston, MA 02114
(617) 626-1174

DEP Team Leaders
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(978) 661-7783
Kevin Brander NERO
(978) 661-7770
Philip Nadeau CERO
(508) 792-7650 x 3728
Tena Davies, SERO
(508) 946-2804

The Executive Office of Environmental Affairs Watershed Teams

Chicopee

***EOEA Team Leader*:** Paul Lyons
Box 628
Belchertown, MA. 01007
(413) 323-8998

DEP Team Leader
Robert McCollum, WERO
(413) 755-2138
Eugene Brunelle, CERO
(508) 792-7650 x 3710

Connecticut Watershed

***EOEA Team Leader*:** John O'Leary
c/o NRCS
243 King Street, Room 39
Northampton, MA 01060
(413) 587-9329

DEP Team Leader
Robert McCollum, WERO
(413) 755-2138

Deerfield Watershed

***EOEA Team Leader*:** Christine Duerring
55 Federal Street
Hayburn Bldg – Room 290
Greenfield, MA 01301
(413) 773-7899

DEP Team Leader
Lawrence Golonka, WERO
(413) 755-2237

Farmington Watershed

***EOEA Team Leader*:** Michael Parker
Hampton Ponds State Park
1048 North Road
Westfield, MA 01085
(413) 532-4450

DEP Team Leader
Lawrence Golonka, WERO
(413) 755-2237

French Watershed

***EOEA Team Leader*:** John Desmond
627 Main Street
Worcester, MA 01608
(508) 767-2787

DEP Team LeaderscEugene Brunelle, CERO
(508) 792-7650 x3710
Robert McCollum, WERO
(413) 755-2138

Housatonic and Hudson Watersheds

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Federal Building – Room 206
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DEP Team Leader
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Ipswich Watershed

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(978) 661-7817

DEP Team Leader Kellie O'Keefe, NERO
(978) 661-7765

Islands (Martha's Vineyard & Nantucket)

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EOEA, Waquoit Bay National Estuary Reserve
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(508) 457-0648

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(508) 946-2767

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The Executive Office of Environmental Affairs Watershed Teams

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Mt. Hope/Narragansett Watershed
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NashuaWatershed
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Parker Watershed
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Lakeville, MA 02347
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SuAsCo Watershed
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Taunton Watershed
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The Executive Office of Environmental Affairs Watershed Teams

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Ten Mile Watershed

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Richard Wiles,
SERO (508) 946-2767

Westfield Watershed

EOEA Team Leader: Michael Parker
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Westfield, MA 01085
(413) 532-4450

DEP Team Leader
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State Agencies

Massachusetts Department of Environmental Protection Bureau of Resource Protection

Dennis Dunn
Watershed Planning Program
DEP Central Regional Office
627 Main Street
Worcester, MA. 01608
(508) 767-2874

Regional Non-Point Source Coordinators:

Northeast Region: Rosalia Barber
(978) 661-7816
Southeast: Jeffrey Brownell
(508) 946-2702
Central: Brian Duval
(508) 849-4027
Western Region: Tracey Miller
(413) 755-2162

Massachusetts Department of Environmental Management

Lakes and Pond Program Coordinator
251 Causeway Street
Boston, MA 02114
Tel: (617) 626-1395
Web site: www.state.ma.us/dem/programs/lakepond/lakepond.htm

Massachusetts Division of Fisheries, Wildlife and Environmental Law Enforcement

Riverways Program
175 Portland Street
Boston. MA 02114
(617) 727-0594 x106
Web site: www.state.ma.us/dfwele/

County Conservation Districts

Cape Cod
PO Box 296
West Barnstable, MA 02668
(508) 771-8757

Dukes
Box 1010
Edgartown, MA 02539
(508) 627-6165

Nantucket
PO Box 1146, Candlehouse Lane
Nantucket, MA 02554
(508) 825-9797

Franklin
243 King St., Room 39
Northampton, MA 01060-2329
(413) 585-1000 ext. 5

Worcester
Medical Arts Center Building
Room 100, 52 Boyden Rd.
Holden, MA 01520-2587
(508) 829-0168 x5

Hampden and Hampshire
243 King St., Room 39
Northampton, MA 01060-2329
(413) 585-1000 ext. 5

Berkshire
78 Center Street (Arterial)
Pittsfield, MA 01201-6117
(413) 443-1776

Bristol
PO Box 475, 84 Center Street
Dighton, MA 02715
(508) 669-6558

Norfolk
460 Main St.
Walpole, MA 02081
(508) 668-0995

Plymouth
Essex Conservation District
562 Maple St.
Hathorne, MA 01937
(978) 774-5578

Middlesex
319 Littleton Road, Suite 205
Westford, MA 01886-4104
(978) 692-9395

Suffolk
PO Box 248
Boston, MA 02121-0248
(617) 265-6647

Regional Planning Agencies

Barnstable County Health and Environment Department
Barnstable (508) 362-2511

Berkshire County Regioanl Planning Commission
Pittsfield (413) 442-1621

Cape Cod Commission
Barnstable (508) 362-3828

Central Massachusetts RegionAl Planning Commission
Worcester (508) 756-7717

Franklin Regional Council of Governments Planning Commission
Greenfield (413) 774-1196

Martha's Vineyard Commission
Oak Bluffs (508) 693-3453

Merrimack Valley Planning Commission
Haverhill (978) 374-0519

Metropolitan Area Planning Commission
Boston (617) 451-2770

Montachusett Regional Planning Commission
Fitchburg (978) 345-7376

Nantucket Planning and Economic Development Commission
Nantucket (508) 228-7237

Northern Middlesex Council of Governments
Lowell (978) 454-8021

Old Colony Planning Council
Brockton (508) 583-1833

Pioneer Valley Planning Commission
West Springfield (413) 781-6045

Southeastern Regional Planning and Economic Development District
Taunton (508) 824-1367

Other Contacts

The University of Massachusetts Cooperative Extension
212 Stockbridge Hall
University of Massachusetts
Amherst, MA 01003-0099
413-545-4800

The Massachusetts Water Watch Partnership
Blaisdell House
University of Massachusetts
Box 30820
Amherst, MA 01003-0820
413-545-5531 or 545-5532
Web site: www.umass.edu/tei/mwwp/
E-mail: mwwp@tei.umass.edu

The Massachusetts Water Resources Research Center
Blaisdell House
University of Massachusetts
Amherst, MA 01003-0820
413-545-5531 or 545-5532
Web site: www.umass.edu/tei/mrrc/
E-mail: godfrey@tei.umass.edu

The North American Lake Management Society (NALMS)
P.O. Box 5443
Madison, Wi 53705-5443
608-233-2836
Web site: www.nalms.org
E-mail: nalms@nalms.org

Massachusetts Watershed Coalition
12 Pleasent Avenue
P.O. Box 577
Leominster, MA. 01453
978-534-0379
Fax: 978-534-1329
Web site: www.ultranet.com/~mwc/index.html

Massachusetts Congress of Lakes and Ponds (COLAP)
135 Washington Street
Holliston, MA. 01746
1800-845-2769
Fax: 508-429-5085
Web site: www.colap.com
e-mail: hildrethcr@aol.com

Massachusetts Lakes and Pond Association-West
e-mail: LAPAWEST@aol.com

Sources of Hydrologic Information

U.S. National Weather Service
Tel: (617) 561-5754
Web site: www.nws.noaa.gov/index.htm

U.S. Army Corps of Engineers
New England Division
696 Virginia Road
Concord, MA 01742-2751
Tel: (978) 318-8338
Web site: www.wes.army.mil/el/aqua

U.S. Geological Survey Water Resources Division
10 Bearfoot Road
Northborough, MA 01532 Tel: (508) 490-5000
Web site: ma.water.usgs

Massachusetts Publications

The Department of Environmental Protection

To obtain these publications contact a DEP Regional Service Center:
Northeast: (978) 661-7677, Southeast: (508) 946-2714,
Central: (5098) 792-7683, Western: (413) 755-2124
Some publications can also be found in the DEP Web site at:
http://www/state.ma.us/dep

Brochures:

- Lawns and Landscapes in Your Watershed
- TMDLs: Another Step to Cleaner Waters
- Don't Trash the Grass

Manuals and Guides:

Volume I: Stormwater Policy Handbook
This handbook provides information on the consistent implementation of the Stormwater Management Policy and performance standards. March 1997

Volume II: Stormwater Technical Handbook
Contains technical information on site planning and stormwater management techniques. March 1997

Nonpoint Source Management Manual: A Guidance Document for Municipal Officials. May 1994 An extensive resource manual covering the causes and possible solutions for nonpoint source problems to Massachusetts waters. Currently out of print and being revised.

Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planneers, Designers , and Municipal Officials. March 1997. A complement to DEP's Nonpoint Source Manual which covers a environmental planning and best management practice principals and methods. This document was produced in conjunction with other state and federal agencies and is currently out of print but will be accessible on the DEP's Web site by 2001.

Eutrophication and Aquatic Plant Management in Massachusetts. This generic environmental impact report being produced in conjunction with the Department of Environmental Management's Division of Water Resources is intended to (1) provide technical guidance on lake management to lake and pond managers, conservation commissions, and citizens; and (2) help local and state officials make informed and consistent decisions about the use of lake management techniques by providing a sound scientific understanding of the potential benefits and drawbacks of each. This guide will be available in early 2001.

Newsletter

"Waterline" is a quarterly newsletter published by DEP's Bureau of Resource Protection. It includes news and information on drinking water, wastewater, wetlands, waterways, and watersheds.

Also available on DEP's web site :

Publications of the Division of Watershed Management, 1963 - 1999
This report contains an index by watershed of 612 technical reports and 63 technical memorandums published by DEP's Division of Watershed Management during the years 1963 to 1999.

1999 Grant and Loan Programs - Opportunities for Watershed Planning and Implementation
The DEP grant and loan programs consist of federal funds from EPA as authorized by the Clean Water Act (sections 604B, 104(b)(3) and 319). Other programs are derived through state appropriation. These include the state bond fund for research and demonstration and state loan programs for municipalities (state revolving loan fund (SRF)) and homeowners (community septic management program). Each of these programs provide an opportunity for watershed initiative planning and/or implementation. Please note the eligibility criteria, time frame for application and Department contacts for further information.

From the Department of Fisheries, Wildlife and Environmental Law Enforcement, Riverways Program
To obtain call (617) 727-1614 x360

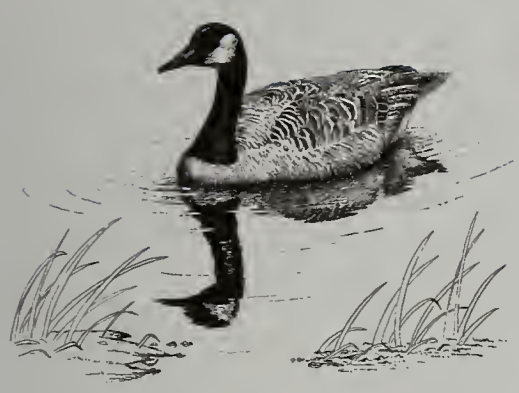
Fact sheet # 8: Functions of Riparian Areas for Pollution Prevention. 1992

Brochures

- The Riverways Programs...Building Partnerships for Protection
- Adopt-A-Stream Program
- Massachusetts Rivers are Coming Back...But They Need Your Help! 10 Ways to Protect Your Favorite River, Brook or Stream.
- Citizen Participation in the NPDES Process--How to Protect Your River or Stream.
- Clean Rivers Begin at Home: A Guide to Understanding Nonpoint Pollution.
- Shoreline Surveys: Action Tool

Newsletter

Published 3 times a year, the Riverways Newsletter gives information about the Riverways and Adopt- A-Stream Programs as they are implemented across the state. It also reports on related activities of community and volunteer citizen groups and other state agencies around the state in protecting watershed resources, rivers and streams.



Guides

Adopt-A-Stream Workbook: How to Protect Your River, Stream or Brook. Step-by-step guidelines for community groups to use in protecting local resources.
Adopt-A-Stream Shoreline Survey: A Stream Team Monitoring Project. Includes setting goals, recruiting volunteers, creating maps, conducting training sessions, gathering and presenting data, evaluating findings, and taking action. (57 pages)
Adopt-A-Stream Educational Packet. A collection of Riverways materials on river resources protection best suited to school and youth groups and lists of related resources.
Guidelines for Gathering and Mapping Ownership and Other Data for River Corridor Lands [excerpt from the forthcoming Riverways' Guide to River Corridor Mapping and Land Protection]. Provides watershed associations with step-by-step suggestions for making a base map showing parcel demarcations within the river corridor. Includes information on land protection and forming a local land trust.

Maps

Massachusetts River Basins: a 2'x3' map depicting the state's 28 major watersheds and the rivers, streams and other major water bodies located within them.
Massachusetts Coastal Zone: a 2'x2' map depicting the coastal watersheds and rivers that flow into the Massachusetts Bays.

Videos

Watershed Protection, Clean Water, and Nonpoint Source Pollution Prevention videos are available for short term loan.

From the Department of Environmental Mangement, Office of Water Resources, Lakes and Pond Program Coordinator: To obtain call: (617) 626-1395

The Lake Book: Actions You Can Take to Protect Your Lake. Developed in conjunction with the Massachusetts Congress of Lakes and Ponds as a resource to lakefront property owners to encourage stewardship of their lake.

From the Department of Food and Agriculture, Pesticide Bureau
To obtain call: (617) 727-3020

A Homeowner's Guide to Environmentally Sound Lawncare: Maintaining a Healthy Lawn the IPM Way. 1997

The SuAsCo Watershed Project

Volunteer efforts go a long way in achieving success, shown by the involvement of volunteers in the SuAsCo watershed. The SuAsCo watershed refers to the drainage area of the Sudbury, Assabet, and Concord Rivers.

The Assabet, Sudbury, and Concord Rivers suffer from excessive algae and aquatic plant growth, low dissolved oxygen, and offensive odors caused by excess nutrients, such as phosphorus, which enter the rivers and tributaries from wastewater treatment plants and nonpoint sources (NPS). Population growth and housing development contributed to the declining water quality by increasing runoff from construction sites and taxed sewer systems. The communities located in the SuAsCo watershed realized that the integrity of the rivers was becoming compromised by the tremendous amount of pollutants finding their way to the water. Recreational activities were becoming jeopardized as plant growth and odors became more prevalent from excessive nutrient pollution. Volunteer associations were organized as a grass roots effort to address the problems that were being created by the accelerated growth of the area. These groups acquired state and federal funding to provide technical aid in the identification of problems found throughout the watershed.

As a result of the volunteer data collected in the watershed associations, the Massachusetts Department of Environmental Protection (DEP) and U.S. Environmental Protection Agency (EPA) categorized the Assabet River as "impaired," which means stricter pollution controls are needed to ensure a healthy river. In 1998, DEP began assessing the amount of pollutants the Assabet River could receive and still meet state water quality standards. This process known as a total daily maximum load allocation, or TMDL, would provide the knowledge and understanding to make many important decisions necessary to restore and protect the SuAsCo watershed community.

The information gathered from the volunteer associations also lead to community-run workshops to educate the public about the hazards and implications of phosphorus, to provide information about phosphorus reduction technologies, and involve communities that are affected by the phosphorus problem. These workshops were sponsored by the Middlesex Conservation District, the Organization for the Assabet River, the SuAsCo Basin Team, and the SuAsCo Community Council, and funded by the Massachusetts Executive Office of Environmental Affairs.

Such community involvement with state and federal agencies will make the realization of a healthier watershed a reality and provide an example for other communities facing a similar situation.

Protecting Your Drinking Water

There are 176 lakes in Massachusetts that are active drinking water sources. Each public water system is responsible for conducting regular inspections of the reservoir and its watershed and for enforcing the protection requirements of the Massachusetts Drinking Water Regulations, 310 CMR 22.00.

The regulations prohibit swimming and other human or animal contact with the water and restrict land uses that may cause contamination of drinking water reservoirs. Other recreational activities on the reservoir and on system-owned watershed lands are left up to the discretion of the local Board of Water Commissioners. The Commissioners consider both the availability of staff and other local resources to adequately monitor recreational activities and the vulnerability of the drinking water source when making their decisions.

DEP encourages the multi-barrier approach to drinking water protection. This includes source protection, water quality sampling, and treatment. DEP helps suppliers, local officials, and watershed groups in their efforts to protect drinking water sources. This assistance includes conducting sanitary surveys, providing guidance manuals and public education materials, technical workshops, and on-site technical assistance.

The Drinking Water Program's (DWP) "Developing a Local Surface Water Supply Protection Plan" offers a step-by-step guide for water suppliers to write a plan that identifies local drinking water protection concerns and specific actions to address them. DWP's Source Water Protection Grant Program provides funds to public water systems, local officials, regional planning agencies, and watershed groups to plan and implement local protection measures.

As part of the requirements of the federal Safe Drinking Water Act, DWP is conducting the Source Water Assessment Program to identify and map potential contaminant sources at the 3000+ drinking water sources in Massachusetts. After meeting with suppliers and local officials to discuss findings, DEP will issue a final report for each system that will include recommendations for improving local protection.

Reports will also be made available to the public. DEP encourages individuals and local groups to assist and support water suppliers in implementing protection measures. Volunteers will find a wide range of opportunities available, from conducting stream surveys to assisting with the development of a local protection plan.

More information about drinking water protection can be obtained by visiting DEP's web site at www.state.ma.us/dep or by calling the Drinking Water Program at 617-292-5727.

Glossary

Algae: Small simple plants without roots, that grow in the water. Blue-green algae are typically found in waters with high concentrations of phosphorus.

Algal Bloom: A growth of algae resulting from excessive nutrient (phosphorus) levels or other physical and chemical conditions that enable algae to reproduce rapidly. The overgrowth of algae can form scums and mats, and reduce the amount of oxygen in water when they decay.

Best Management Practices: (BMPs) Conservation practices to reduce nonpoint source impacts from construction, agriculture, timber harvesting, marinas, and stormwater. Information describing these techniques has been developed by Massachusetts (see appendices E and G).

Biological Contaminant: (pathogen) An agent such as a virus, bacterium, or fungus that can cause disease in humans.

Buffer: (vegetated buffer) Areas of vegetation, left undisturbed or planted between a developed area and a waterbody. Buffer vegetation should include trees, shrubs, bushes, and ground cover plants.

Channel: A pathway to carry runoff, such as a ditch between two banks or the bed where a natural stream of water runs.

Channelized Flow: Flow that is concentrated in a channel, rather that spreading thinly and evenly over the land surface.

Coldwater Fishery: Fishery habitat that supports trout and salmon.

Comprehensive Lake Management Plan: A plan to protect lake water quality by including educational and regulatory measures to minimize phosphorus and other pollutant inputs from new development in the lake watershed as well as existing development.

Contour: An imaginary line on the surface of the earth, or a line drawn on a map, connecting points of the same elevation.

Culvert: A conduit through which surface water can flow under or across roads and driveways. Culverts are usually a pipe and can be made of metal, wood, plastic, or concrete.

Cultural Eutrophication: The accelerated aging process of lakes by human activities that overload waterbodies with nutrients and sediments.

Cumulative Impact: The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.

Database: A collection of data (such as water quality monitoring data, soils data, and land use data.) that has been arranged for ease and speed of retrieval, usually by computer.

Demonstration Project: A project or a place that is used to demonstrate how to implement best management practices to reduce or eliminate polluted runoff.

Ditch Turnout: A best management practice used to direct runoff in a ditch into a vegetated buffer. This shortens the distance that runoff travels in a ditch, thus reducing volume and speed of the water traveling in the ditch and preventing ditch erosion. A turnout prevents runoff in a ditch from reaching a stream or other water body by directing water into a vegetated buffer.

Diversion: A best management practice used to intercept and direct surface runoff. Diversions are usually channels or depressions with a supporting ridge on the lower side, constructed across or at the bottom of a slope.

Duff Layer: A layer of needles, leaves, and decaying organic matter on the forest floor.

Ecosystem: The interacting system of living organisms with one another and their physical environment.

Erosion: Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this detachment.

Erosion Controls: Physical measures installed prior to and through the duration of filling or grading activities in order to prevent soil erosion. A silt fence is an example of an erosion control; it is a physical barrier installed along the perimeter of a earthmoving activity. Water can pass through the fence but soil cannot. Hay mulch is another example; when spread over bare soil it prevents rainwater from eroding the soil.

Flushing Rate: The time it takes for the entire volume of the lake's water to be exchanged, usually expressed in years. Lake biologists calculate the flushing rate by dividing the annual water outflow from the lake by the lake volume. This information is useful to determine the lake's sensitivity to inputs of phosphorus and pollutants.

Food Chain: A representation of the succession of organisms in a community through which energy is transferred. Each type of organism is a "link" in the chain, which feeds on and obtains energy from the one preceding it and in turn is eaten by and provides energy for the one following it.

Habitat: A place used by plants and animals to live, feed, find shelter, and reproduce.

Impervious Surface: A hard surface area that either prevents or retards the entry of water into the soil as under natural conditions prior to development and/or a hard surface area that causes water to run off the surface in greater quantities and at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways parking lots, storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam, or other surfaces.

Intermittent Stream: A stream that flows during part of the year.

Lake Ecology: The study of living things in and around a lake and their relationships to each other and their environment.

Metabolism: The chemical and physical processes of an organism in order that maintain life.

Mitigation: Corrective action to eliminate nonpoint pollution sources from a watershed, or to reduce their impacts on a water body.

Monitoring: (water quality monitoring) Assessing the condition of a waterbody over time by collecting physical, chemical, or biological information.

Mulch: A layer of hay of other material covering the land surface that holds soil in place so that it does not erode. It aids in the establishment of vegetation by holding the soil in place, conserving moisture, and minimizing temperature fluctuations.

Nonpoint Source: An indirect discharge, not from a pipe or other specific source, usually as a result of stormwater runoff.

Nutrients: Any substance required by plants and animals for normal growth and maintenance. Enriched nutrient loads from land runoff, septic systems, and atmospheric deposition can result in excessive growth of algae and lead to degradation of water quality. Phosphorus is generally the nutrient of concern in lakes.

Phosphorus: An element found throughout the environment; it is a nutrient essential to all living organisms. Phosphorus binds to soil particles, is found in fertilizers, sewerage, and motor oil, and is found in high concentrations in stormwater runoff. The amount of phosphorus present in a lake determines the lake's production of algae. A very small change in phosphorus levels can dramatically increase algae growth.

Phosphorus Control Method: A methodology that sets forth criteria to minimize phosphorus entering a lake from new development in a lake watershed. The method is used by towns to review new development plans, and by developers as they plan new development.

Phosphorus Load: The amount of phosphorus entering a lake in a given time period.

Point Source: Any confined and discrete conveyance (usually a pipe) from which pollutants are or may be discharged into a watershed.

Polluted Runoff: Runoff that has picked up contaminants or nutrients from the landscape (or air), as it flows over the surface of the land to a waterbody.

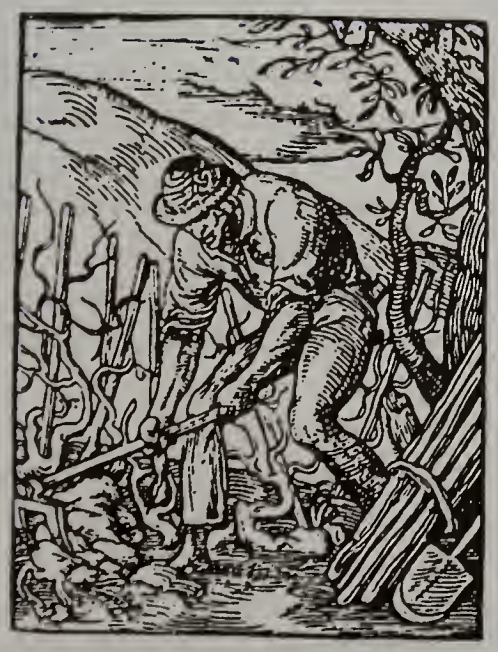
Project Manager: The person that leads and manages the watershed survey project

Rills: Small gullies or channels that can be seen on the surface of bare soil as a result of soil particles being washed away through erosion.

Runoff: Precipitation or snowmelt that runs off the land and into waterbodies. It can carry pollutants from the air and land into a water body (polluted runoff).

Saturated: Soaked with moisture and unable to hold or contain more. A saturated soil has all of the spaces between the individual soil particles filled with water.

Scouring: As it pertains to this manual, the removal of soil particles by stormwater runoff from streambanks, channels such as ditches, or other areas.



Sector: (Survey area) A geographic portion of the watershed assigned to a survey team.

Sediment: Mineral and organic soil material that is transported in suspension by wind or flowing water, from its origin in another location.

Sediment Loading: The amount of sediment entering a lake.

Silt Fence: A physical barrier used to control the erosion of soil. It is made of a plastic fabric that allows water to pass through and not soil.

Site: The location or place of something. As it pertains to watershed surveys, the place that is generating polluted runoff.

Stakeholder: Anyone who lives in the watershed or represents major land uses or interests in the watershed.

Stormwater Runoff: Runoff caused by rain or snow storms.

Stream: (River, stream, or brook) A channel between defined banks including the floodway and associated flood plain wetlands where the channel is created by the action of the surface water and characterized by the lack of upland vegetation or presence of aquatic vegetation and by the presence of a bed devoid of top soil containing waterborne deposits on exposed soil, parent material or bedrock.

Surface Water: Water that has a surface exposed to the atmosphere.

Swale: A natural depression or a constructed wide shallow ditch that runoff flows through.

Technical Team: In a watershed project, the individuals responsible for providing training, technical advice, and review and analysis of data gathered by the steering committee and volunteers.

TMDL: A total maximum daily load (TMDL) is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards for protecting public health and maintaining the designated beneficial uses of those waters for drinking, swimming, recreation, and fishing.

Topographic Map: A map that represents the shape of the land surface with contour lines and the location of physical features such as waterbodies, streams, woods, buildings, and roads. Contour lines can be used to measure the height of mountains or the steepness of slopes. The US Geological Survey has produced topographic maps of all of the land in the United States.

Topography: The physical features of a region such as the relief of the landscape and positions of waterbodies.

Toxic: Poisonous, carcinogenic, or otherwise directly harmful to humans and other living creatures.

Tributaries: Streams or rivers that flow to a larger body of water.

Turbid: A term used to describe water that is clouded by soil or organic particles.

Vegetated Buffer: Areas of vegetation, left undisturbed or planted between a developed area and a waterbody that are used to capture pollutants from surface water and groundwater. Buffer vegetation can include trees, shrubs, bushes, and ground cover plants.

Velocity: The speed of an object or substance.

Volunteer Coordinator: In a watershed project, the person that serves as a point of contact for volunteers, coordinates the volunteer activities, and collects data gathered by volunteers. The volunteer coordinator serves on the steering committee.

Waterbar: A diversion ditch and/or hump installed across a trail or road to divert runoff from the surface before the flow gains enough volume and velocity

Water Body: Watercourse or lake, pond, river, stream, or ocean.

Water Quality: Pertaining to the presence and amount of pollutants in water.

Watershed: The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges of land separating watersheds. All land is located in a watershed.

Watershed Management: The long term management of the watershed through phases of assessment, planning, and implementation and evaluation. Throughout these phases, education plays a major role in reaching set goals.

Wetlands: Low lying areas inundated or saturated by water at a frequency and duration sufficient to support wetland vegetation. Some of their valuable functions to include holding runoff, and removing pollutants through a series of chemical, physical, and biological mechanisms.

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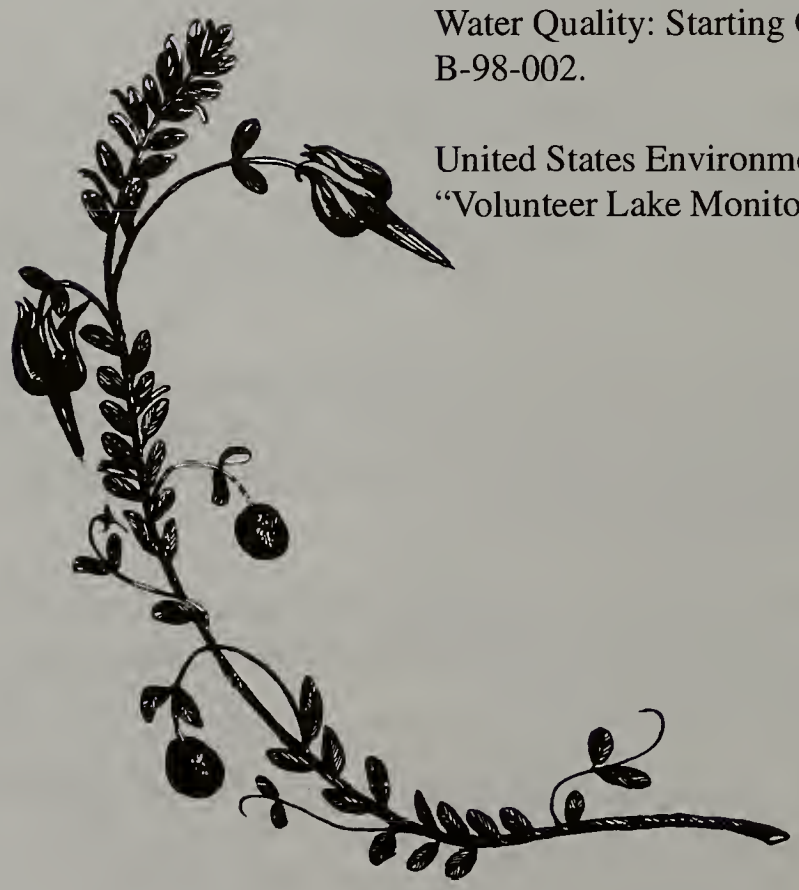

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